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Devoted to the interests of the engineers and technical officials of the cities, counties and states

NOVEMBER, 1939

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Contents

EDITORIAL 19

GENERAL:

Aerial Engineering and Public Works. *By Herbert Thayer Bruce* 20
A Laboratory Concrete Mixer 35

HIGHWAYS AND STREETS:

Ending Rough and Dusty Gravel Roads. *By F. P. G. Halbfass* 13
Eliminating Dust Reduces Maintenance Costs 23
Equipment Used in Snow Removal and Mileage Cleared 27
Ice Control Practices 28
Soil Classification by Weight 36

SEWERAGE AND SEWAGE TREATMENT:

Sand Hog Box Speeds Sewer Construction in Wet Ground 16
English Designs for Sewer Manholes 17
Two Years' Experience with Chemical Treatment of Sewage. *By T. R. Haseltine* 31
A Small Up-to-Date Sewage Treatment Plant 37
The Sewerage Digest 38

WATER SUPPLY AND PURIFICATION:

21-Mile Concrete Pressure Pipe Line and Dam Feature Bethlehem's New Water Supply 9
Methods and Practices in Sterilizing Newly Laid Mains 24
Cathodic Corrosion Eliminators at Treasure Island. *By C. W. Geiger* 30
Iron Bacteria—A Correction and a Credit 30
The Waterworks Digest 42

DEPARTMENTS:

Keeping Up With New Equipment 49
Readers' Service 55
The Engineer's Library 58

TIMEWASTERS

A "O" more or less doesn't make much difference, except with Timewasters, now and then a banker, and a few engineers. In our October dissertation on the field with the board fence along it, we inadvertently—not ignorantly—left off that vital 0 on the end. The field contains 92,160 acres and the fence contains 92,160 boards. Some of these expert Timewasters are more particuler about these little things than a bridge partner. Our apologies for the mental anguish we caused so many of our readers.

The peg problem in the October issue requires 256 moves, 128 moves being required to move No. 8 ring, and the rest of them to get things back shipshape again, and right side up.

The phantom division problem has two solutions, at least, and maybe more. Mr. Crawford says 12042807 ÷ 123 = 97909, which appears to meet the conditions of the problem. Mr. Aldridge from up in Manitoba says that 12128316 ÷ 124 = 97809, which also appears to meet the problem. Mr. Aldridge also says that according to his figures, by series formula, the rings mentioned above would require 255 moves.

Time for Toast:

An electric toaster which requires turning and to know when to reverse the bread accommodates two slices of bread and requires 30 seconds to toast one side of each slice. What is the minimum total time required to toast three slices of bread on both sides, neglecting time spent for handling the bread, flipping, etc? *W. Vernon Brumbaugh.*

Commuters Special:

The number of telegraph poles that the train passes in 1 min. and 40 seconds is the same as the speed of the train in miles per hour. How far apart are the poles. *W. A. H.*

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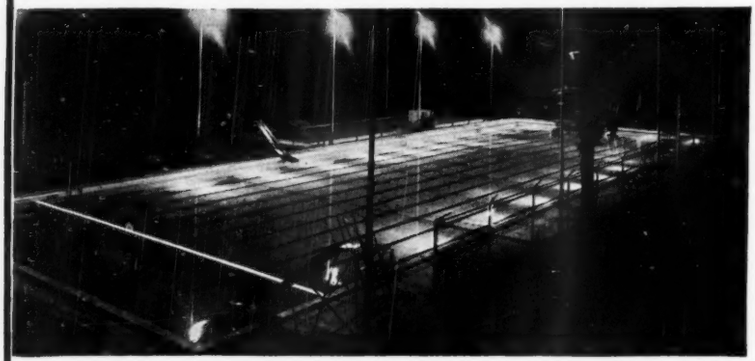

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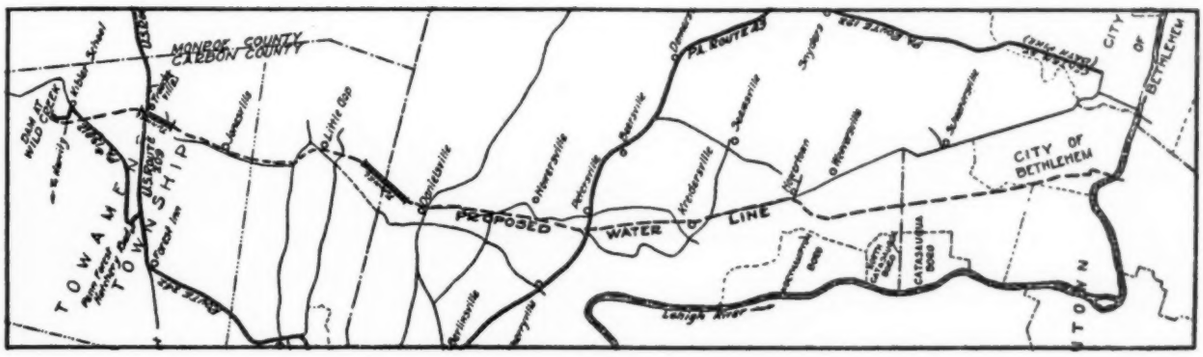
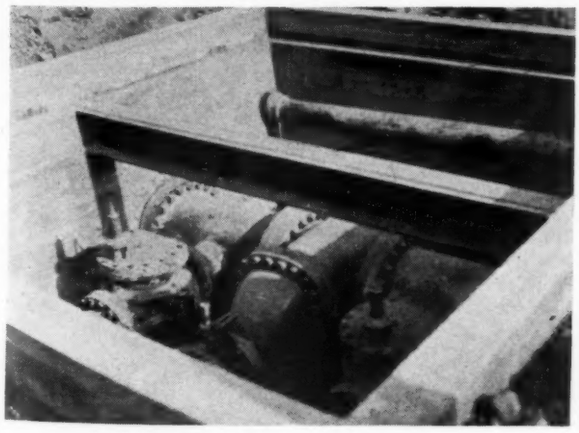


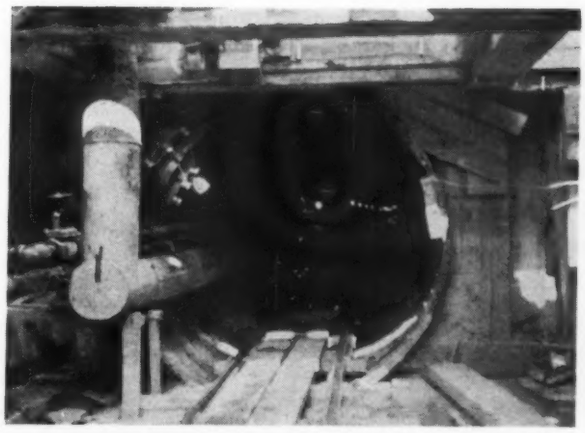
Location of pipe line between Wild Creek dam and Bethlehem

21-Mile Concrete Pressure Pipe Line and Dam Feature Bethlehem's New Water Supply

CONSTRUCTION work now under way will bring water to the city of Bethlehem, Pa., from Wild Creek, some 23 miles from the city. The project, which is being carired on under a PWA grant, involves an earth dam about 150 feet high and 1160 feet in length; control works and an operating and chemical house; three tunnels, about 5890 feet, 4600 feet and 950 feet long, respectively; about 21 miles of 36, 30 and 24-inch pipe line; and some additional booster and feeder lines. The total cost will be about $3,500,000 and the work will be completed late in 1940.



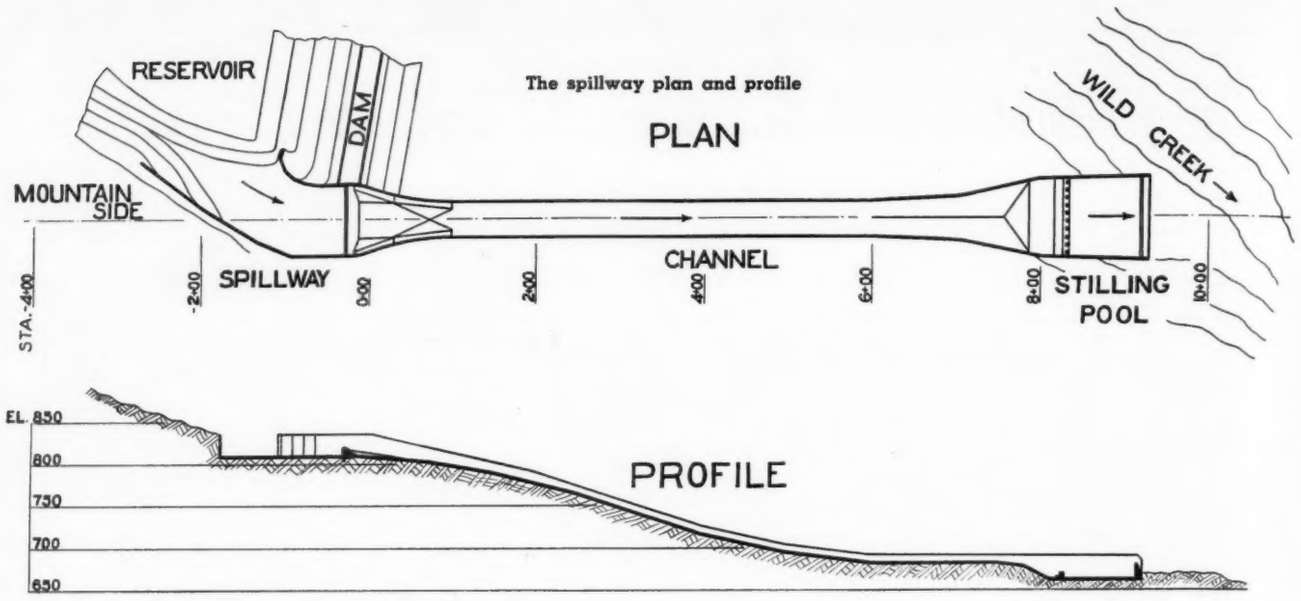
A control box: Darling valves were used.



Armco tunnel liners were used in earth.

Bethlehem's water supply hitherto has been obtained from two sources — the Lehigh River which flows through the city, and wells at Illecks Mills, just outside of the city. Consumption is about 7 million gallons per day, of which 75 per cent is supplied by the river and 25 per cent from the wells. The new supply will yield 12 to 16 million gallons a day.

Both river and well water are hard—179 and 212 parts per million respectively; the river water is quite heavily polluted, filtration of course being necessary.



The spillway plan and profile

The filter plant is operating at about capacity, and extensions would be required if the use of the river water were continued. On the other hand, the Wild Creek water is soft, clear and of good sanitary quality, so that only chlorination will be required. On the basis of annual cost, the new supply is a paying proposition.

Principal contracts were for the 21-mile pipe line (Contract No. 3), for the two longer tunnels, and for the dam and appurtenant structures. In addition, a number of relatively minor lines were involved in the work. Near the city two booster lines were built—14-inch and 12-inch, both cast iron. To connect the wells at Illecks Mills with the new line, 13,500 ft. of 20-inch steel pipe were laid under Contract No. 2.

Contract 3, which is shown quite clearly on the accompanying map, extends from the Lehigh River to the dam, exclusive of the two large tunnels, and provides for furnishing and laying the pipe. This was awarded to Lock Joint Pipe Co., Ampere, N. J.

This section included the crossing of the Lehigh River, of a canal and of two sets of railroad tracks. The river crossing was accomplished by laying the pipe by divers in a prepared trench in the bed of the river. The canal was crossed by means of a cofferdam, laying one-half the crossing at a time. The railroads—the Central of New Jersey and the Lehigh Valley—were tunneled under.

All of the main-line 24 in., 30 in. and 36 in. pipe is Lock Joint steel cylinder reinforced concrete pressure pipe. The ends of each pipe are formed by galvanized steel joint rings welded to the steel cylinder. These joint rings are so formed that they are self centering when laid and water tightness is assured by a rubber gasket in the case of the 24 in. and 30 in. pipe and by a fibre-filled lead gasket for the 36 in. diameter pipe. These joints permit expansion and contraction due to changes in temperature and have the flexibility to permit settlement of the pipe due to normal earth movement. Minimum wall thickness specified for these pipe were as follows: 24 in. and 30 in. pipe 3¼ in. wall; 36 in. pipe 3½ in. wall.

Approximately 13,000 feet of the 24 in. pipe were

Lock Joint's pipe-making plant

The portable drilling outfit

Laying 36" Lock Joint pipe and backfilling. Note fragments of blasted rock.

made in 14 foot lengths; design heads ranged from 460 feet to close to 600 feet. The 30 in. pipe, of which there was approximately 68,500 feet, was made in 16-foot lengths; design heads ranged from 245 feet to over 500 feet. Approximately 27,700 feet of the 36 in. pipe made in 16-foot lengths; design heads ranged from 205 feet to over 400 feet.

In order to maintain a satisfactory manufacturing schedule it was necessary to pour 50 pieces of pipe per day. A manufacturing yard was set up in Danielsville on the L. & N. E. Railroad. Provisions were made for pouring thirty 30 in. pipe each day together with twenty 24 in. pipe. After all of the 24 in. had been manufactured, twenty 36 in. pipe were poured each day in place of the 24 in. pipe. J. A. Tapley was plant superintendent.

All of the material for the pipe was delivered by rail. The cement arrived in bulk, the sand and gravel in dump cars. Steel sheets were delivered flat, hot rolled rods, for reinforcing, in coils and the galvanized steel joint rings were received in their final shape.

The fabrication of the steel cylinders and reinforcing cages is the first step in manufacturing the pipe. Cylinders are formed from the flat sheets rolled to proper diameter and welded longitudinally with joint rings welded to each end. The outer reinforcing is a spirally wound cage of hot rolled rods held rigid by No. 8 ga. wire. A cage is placed around each completed cylinder and this steel structure is delivered to the manufacturing yard.

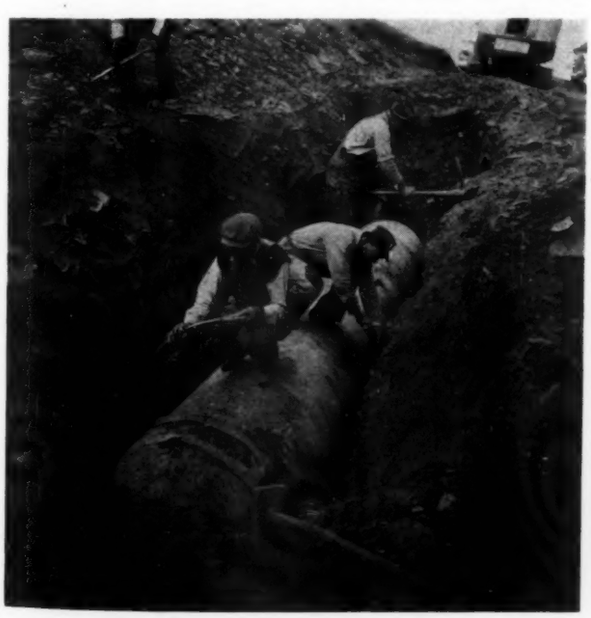
In the manufacturing yard all materials are weighed and batched in a Johnson bin and batcher capable of holding 50 yards each of cement, sand and gravel. An American locomotive crane performs all of the manufacturing operation, i.e., setting up and dismantling the steel molds, placing the steel structure on the base rings, picking up the buckets of concrete from the batcher, pouring the pipe and finally tipping the pipe. The concrete is compacted in the molds with the aid of vibration.

After being poured the pipe is enclosed in a steam box and live steam is allowed to circulate through and about the molds. On the following day the molds are stripped from the pipe which then remains in the steam box until the third day. On the third day the pipe is tipped out and rolled into the storage yard. Here it is covered with burlap and kept moist for a period of two weeks. After this time the pipe is ready for delivery.

The total amount of concrete used in the construction of the pipe exceeded 10,000 cubic yards. The total quantity of steel used was approximately 5,000 tons.

The pipe was delivered on long bodied trucks. Each truck customarily carried two pipe per trip. The average haul over the entire job was about ten miles. All of the 30 in. and 36 in. pipe is being installed by the Lock Joint Pipe Company, the 24 in. pipe and accessory piping being installed by E. R. Morehouse, Camden, N. J., under sub-contract to the Lock Joint Pipe Company.

Contract No. 2, involving 13,500 feet of 20 in. steel pipe, is practically completed. This was built by Malone & Sons, Lancaster, Pa. The pipe was furnished by Lancaster Iron Works. It was coated inside and out



Tamping around the pipe

Backfilling with a bulldozer

Left to right, J. A. Tapley; J. G. Conrath, and J. J. Malone

with Wailes Dove-Hermiston bitumastic enamel. About 80 per cent of the joints were made with Dresser couplings, the remainder being flange joints.

Construction methods on all pipe lines were essentially the same. Power shovels were used for trenching and for handling the pipe into the trench for jointing. Several methods of backfilling were used.

On the 36 in. and 30 in. lines installed by Lock Joint Pipe Co., three Northwest shovels were used. These were of the pull-shovel or trench-hoe type. The shovel operates backward, straddling the line of the trench, digging and casting the dirt to one side so that it can be handled for backfilling by bulldozers. When sufficient trench has been opened, the shovel picks up a length of pipe by means of a wire rope sling, places it in the trench, enters the spigot into the bell and holds it until the section is blocked in place. It then moves backward, excavating more trench, and repeats the performance.

Lock Joint has two Ingersoll-Rand air compressors and drills mounted on Allis-Chalmers tractors for rock work. When rock is encountered, one of these units is moved up, holes sunk, the rock blasted, the trench completed and the pipe laid. For backfilling, Baker bulldozers mounted on Allis-Chalmers tractors are used.

On the Morehouse job, a Keystone excavator was used in the same manner for trenching and laying the pipe. On the Malone contract, a ⅜-yard Insley excavator and a Universal truck-mounted shovel were used. A tractor and dragboard were used for backfilling.

Usual methods were employed in drilling the two long tunnels. The contractor on both tunnels was the Kaufman Construction Co. of Philadelphia, but the shorter of the two was sublet to Hugh Dolan & Co. of Pottsville, Pa. The short tunnel at the dam was included in the dam construction contracts of C. W. Good & Co., Lancaster and Reading.

Earth sections of the tunnel were lined with Armco corrugated iron liner plates to a diameter of 84 inches. In loose rock a concrete lining was placed. In all the tunnels, a 38 in. steel pipe line was placed. Work on the tunnels proceeded from both ends. At tunnel No. 1 the power plant consisted of Gardner-Denver compressors operated by a Caterpillar power unit.

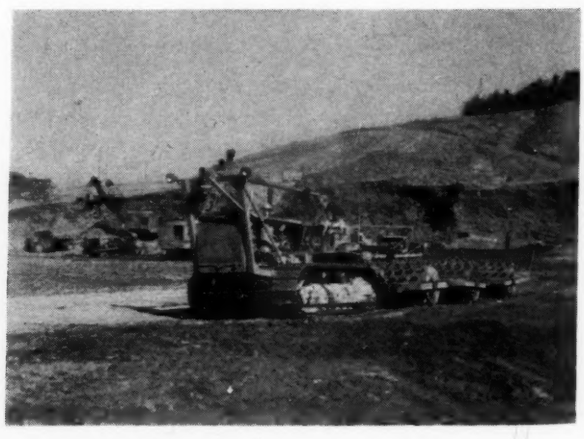
The dam is of rolled earth, with a core of selected materials. A low concrete wall is provided as a tie to existing rock. The faces of the dam are variable in slope but average nearly 1 on 3.

During construction, the flow of Wild Creek is being diverted through a concrete culvert 17 feet in diameter, which will be plugged with concrete when the dam is completed. A spillway is provided at the right of the dam; on the left is the intake tower. This differs from the usual design in that a channel will be cut in the hill which forms the left buttress of the dam to the tower which will be just upstream from the center of the dam. From the intake tower a tunnel 950 feet long carries the water to the control and chemical house. Treatment will probably include the addition of lime to increase the alkalinity of the water and chlorination for disinfection.

The surface area of the lake is about 300 acres and the storage capacity about 4 billion gallons. The drainage area above the dam is about 22 square miles. Because of its flashy runoff, the spillway was designed to handle 17,500 cubic feet per second or about 875 cubic feet per second per square mile.

In order to determine the best shape for the spillway to carry the flow from the top of the dam some 1200 feet to the creek bed 160 feet below, a model on a scale of 1:36 was built in the hydraulic laboratory of Lehigh University. This was tested and modified to the plan and profile shown herewith. Tests indicated that the water attained a velocity of about 40 miles per hour in the channel. The original plan contemplated a reduction in the channel width which the model showed would set up waves that would spill over the side walls. This was corrected by changing the contraction ratio just below the spillway. It was found that by crowning the channel floor between 0+00 and 2+00 and between 7+00 and 8+00, a smooth flow was obtained. A row of concrete cubes at the entrance to the stilling pool breaks the force of the entering water and permits a uniform overflow into the creek. A small opening in the stilling pool permits this to drain.

This work is being carried out by the Bethlehem Municipal Water Authority, of which Robert L. Fox, city engineer of Bethlehem, is chief engineer; J. G. Conrath is assistant.



Spreading (left) and compacting fill material for the dam

The finished stabilized wearing course, after surface application of calcium chloride.

Ending Rough, Dusty Gravel Roads in Muscatine Co., Iowa

By F. P. G. HALBFASS

County Engineer, Muscatine County, Iowa

Left, F. P. G. Halbfass, Muscatine County engineer; Right, Jim Cameron, Supt. of construction, Cameron-Joyce Co.

LOOSE gravel roads are being attacked in Muscatine County because of the waste of material, need for daily maintenance, dust and corrugations that feature them. They were made by applying loose mineral aggregate to the dirt surface, and maintained by the loose gravel mulch method. While such roads do not become impassable, as the old mud roads did, they definitely do not satisfy the needs of modern vehicular traffic where there is much concentration of it. Loose gravel mulch is a serious skidding hazard and reduces safe travelling speed. Dust is a nuisance to those using the road and residents along it, and a danger factor to the former. Continuous blading is required to minimize corrugations. And last but not least, the gravel is constantly being ground up by traffic and blown or thrown off the road, necessitating substantial annual replacements.

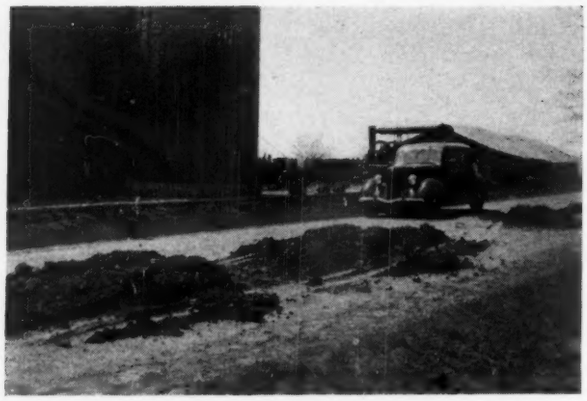
Replacing such roads with improved types involves the problems not only of finance, but, even more important, of decision as to what type is best for each case. No one formula is applicable the country over or even the county over; success or failure are dependent on nature of soils, climate, topography, community industries and other factors.

Believing that actual experience is the only certain method of selecting the type best for a given locality, Muscatine County is experimenting this year with three different methods on various sections of its roads. We now plan to sit back and wait for the severe seasons to tell us how each of these fit our many varied needs. The types being tried are:

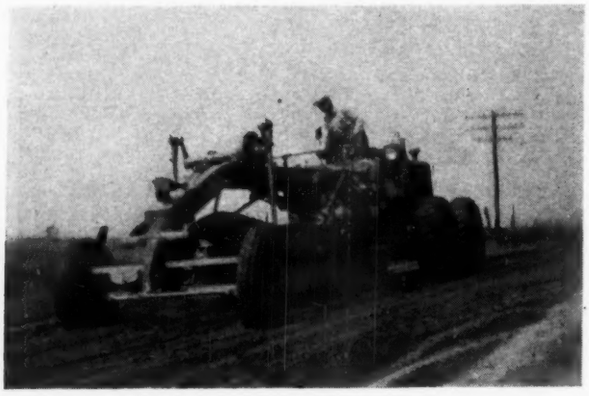
1. A light bituminous top on a constructed stabilized base. This is being tried on four sections of county trunk roads, totaling 8 miles.

2. A stabilized and compacted 2-inch wearing crust surface treated with calcium chloride. This is on two sections of county trunk roads, totaling 8 miles.

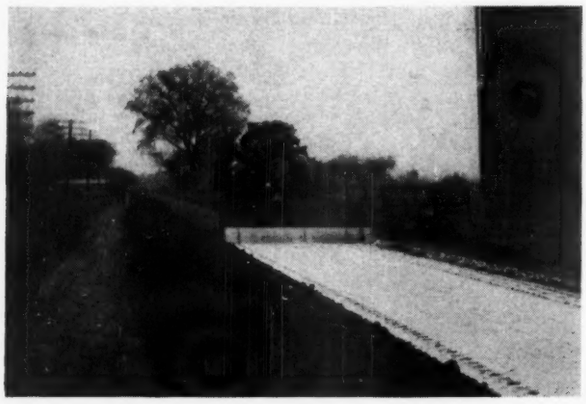
3. Surface consolidation of existing road materials



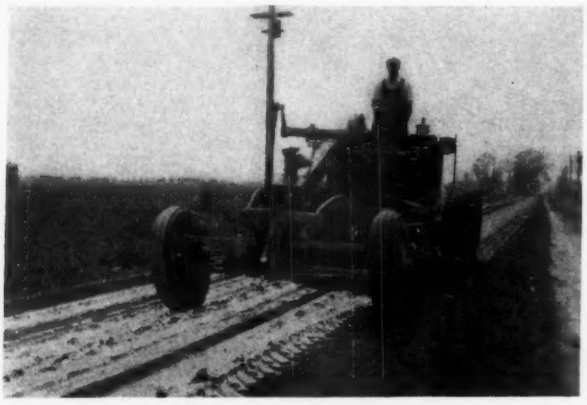
Binder soil delivered on roadway for mixing with aggregate shown windrowed in background.



Spreading and partially mixing of windrowed materials



Calcium chloride admixture is introduced into the partially mixed materials on the roadway.



Mixing soil materials and calcium chloride with motor grader.

treated with calcium chloride. This is on two sections of road totaling 1 mile.

The road sections upon which these are being tested had long been maintained by the loose mulch method and consequently contained considerable old aggregate.

In order to have full control of all the specification and construction requirements and have immediate and constant information on results, we set up a complete soils and materials laboratory. Services of the Iowa Highway Commission's testing department were also made use of for comparative checking. Our laboratory inventories at $350. All test determinations in it are under direction of one assistant, E. J. Wheeler.

Constituting Type 1. Under the type designated as (1) we scarified, shaped, watered and consolidated the old gravel surface to a 6″ "A" crown, keeping a constant check on consolidations by laboratory control. On this we built a stabilized 3″ base, 20 feet wide, and then applied a ¾ inch bituminous wearing surface by the blotter or inverted penetration method, after first priming the new base. For the 3″ base the predetermined quantities of new aggregate and binder soil were windrowed along the road separately. The clay was minutely pulverized, mixed with the gravel, and then spread with a motor grader. At this point, calcium chloride equivalent to 1½ pounds per square yard of surface was introduced as an admixture, water applied and mixing then proceeded with a disc harrow, spring tooth harrow and motor grader. After the thoroughly mixed mass had been leveled off, compaction was obtained by means of sheepsfoot rollers, followed by a multiple-wheel truck tire roller.

We found that thorough pulverizing of the clay and its thorough mixing with the aggregate is of great importance; that the most exacting laboratory control is necessary; that rains coming before the clay was thoroughly mixed in with the aggregate was a detriment, but that rains that came after were a benefit and decreased watering operations on the road; that when the mixture reached the right moisture content it rapidly compacted; that calcium chloride assisted in controlling the moisture content and lessened watering operations (the chloride should greatly lower the freezing point of the base); that the base must not be primed until its moisture content is 5 per cent by weight, or below, to permit proper penetration of the prime and avoid creeping of the wearing surface after road is opened to traffic.

Additional mixing with spring-tooth harrow.

While we cannot at this time predict the ultimate result of our base stabilization work, tests revealed that our mixtures are of high quality. In fact, tests of one of the base sections showed a density of 156.25 pounds per cubic foot at age of two months. The minimum of all tests was 148½ pounds.

The following gradation of stabilized materials is typical of our best base mixture to give a low plasticity index:

Material	*Percent*
Passing 1 inch sieve	100
Passing ¾ inch sieve	96
Passing ⅜ inch sieve	89
Passing No. 4 sieve	82
Passing No. 8 sieve	69
Passing No. 40 sieve	27
Passing No. 200 sieve	9

This particular mixture had a plasticity index below 6, and in all our base mixtures the P. I. was kept below 7½.

Constructing Type 2. This wearing surface mixture differed from the base mixture in (1) in that artificially added water and calcium chloride is no part of the mix.

The old surfacing material was salvaged and stock piled and the road was then reconstructed and shaped to a 6" "A" crown and compacted by rolling. After this, the salvaged material, new material and binder soil were windrowed along the roadway, mixed with a motor grader and spread. Moisture was made dependent on weather, and compaction depended on traffic.

The amount of salvaged road material satisfactory for use was determined by gradation analysis and varied some on the different sections. To secure a suitable stabilized surface mixture on the average section, we found that we could use 32 percent of the salvaged material, 50 percent of new crushed Class "A" specification stone, plus 18 percent of stone dust as a binder. There were sections on which we could not satisfactorily use any of the old road metal. On the average section here, we found we could use 94 percent of a gravel mixture and 6 percent of clay binder from a certain source.

The following graduation of stabilized materials is typical of the surface mixtures we produced:

Material	*Salvage Stone and Dust Mix*	*Gravel and Clay Mix*
Passing 1 inch sieve	100	100
Passing ¾ inch sieve	89	96
Passing ⅜ inch sieve	71	78
Passing No. 4 sieve	57½	56
Passing No. 8 sieve	44½	39
Passing No. 40 sieve	22½	10
Passing No. 200 sieve	9.3	—

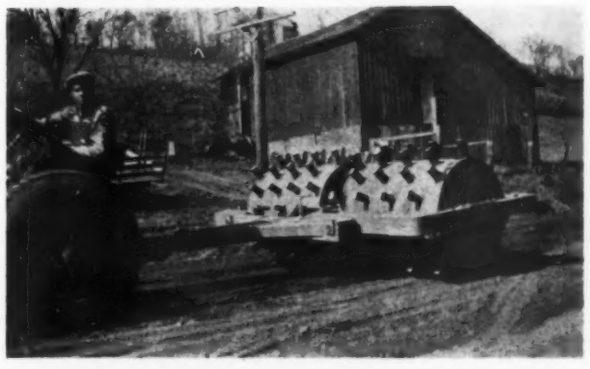
These particular mixtures gave a plasticity index of 8 on the former and 10 on the latter. The P.I. for this wearing surface was kept higher than the P.I. for the base course.

Constructing Type 3. This project involved reshaping and consolidation of an existing gravel surfaced road.

On this project we utilized all the existing road material, and through "cut and try" methods attempted to readjust the soil proportions so as to produce a stabilized mixture. As is usually the case in loose gravel surfaces, we found that the road required an addition of road-side binder—soil secured by regrading the ditches—to provide cementing action, and then additional aggregate spotted lightly, here and there, to take up surplus binder. After the new material had been thoroughly blended with the old through drag blade mixing, we treated the surface with calcium chloride as in type (2) to furnish the necessary moisture bond.

Still further mixing is done with disk-harrow.

Additional moisture is added prior to compaction operations.

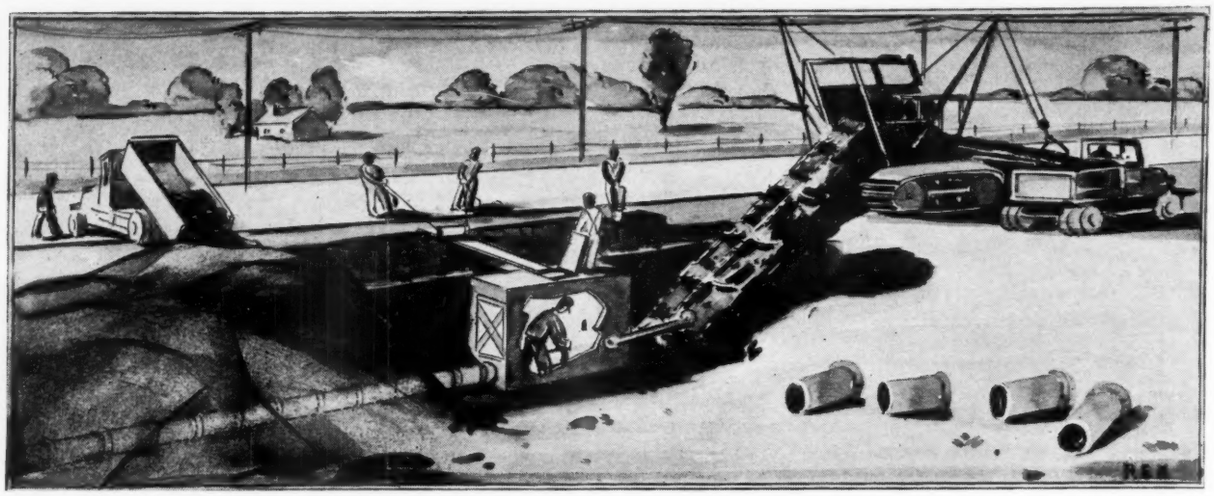


Compacting stabilized materials with sheeps foot roller.

Multiple-wheel truck tire roller is also used for compaction.

As pointed out earlier in my article, we will be unable to tell, until the roads have gone through the winter season, which type is best suited to the needs of various roads.

There was, of course, a great difference in cost between the three methods used, and this factor will have to be considered in our analysis of the results obtained.

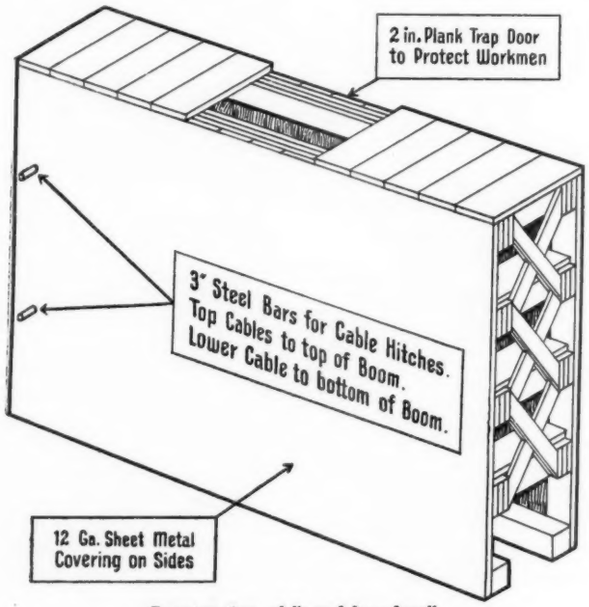


Cut-away view of sand hog box in use. Trench excavator at right. Backfilling at left.

"Sand Hog Box" Speeds Sewer in Wet Sand

Laying sewers in trenches 14 to 24 ft. deep in wet, mobile sand in Shawneetown, Ill., proved impracticable with hand labor and not much less so with trenching machines. The home-made device that solved the problem is described in this article.

SHAWNEETOWN, county seat of Gallatin county, Illinois, has for 140 years been the victim of periodic Ohio river floods which spread death and destruction. It was the site of the first bank in the State, of which it was the thriving gateway, and supplied most of the county with salt. But with the decline of river commerce, discovery of salt deposits elsewhere, and recurring floods, it gradually had become an impoverished, flood-wrecked community, some half of whose employable citizens were on some kind of public relief. The flooding problem it was decided to meet by relocating the town on higher land. In this major project the town, Gallatin county and the State cooperated with the Work Projects Administration and other Federal agencies. It includes moving old buildings to the new site and constructing new houses, public buildings and facilities, including a sewer system.


2 in. Plank Trap Door to Protect Workmen
3" Steel Bars for Cable Hitches. Top Cables to top of Boom. Lower Cable to bottom of Boom.
12 Ga. Sheet Metal Covering on Sides

Construction of "sand hog box"

In the construction of the sewer system, the fine, wet, mobile sand that comprises the soil of the town site presented an almost insurmontable obstacle to WPA engineers and workers.

Plans were made originally to dig most of the sewer trenches by hand in order to give employment to a maximum number of laborers, but the very nature of the soil forbade hand work. Trenches more than four or five feet deep—and even shallower ones, if they stood for any length of time—had to be shored, and those dug to depths of from 14 to 24 feet, where most of the sewer lines were located, required extraordinarily heavy and expensive trench bracing. This condition of the soil made the trenching excessively expensive, as well as hazardous for the workers.

When the impossibility of using hand labor was established, a trenching machine was obtained to do the excavating. But again the sandy soil prevented successful work. It was found that in order to lay a 15-inch sewer tile, it was necessary to excavate a trench of an average width of 25 to 30 feet, and also to handle from eight to ten cubic yards of earth per foot of trench.

The trenching machine was being heavily overloaded and seemed certain to break down if the work was continued. Economy on this job was an urgent necessity but laying of sewers in the sandy soil appeared inevitably to be an expensive process.

To do the job cheaply, Captain F. H. Morgan, general superintendent of the WPA project, and T. J.

(Continued on page 26)

English Designs for Sewer Manholes

Suggestions for American Engineers Offered by English Manhole Designs

PLANS for structures generally and widely used, such as sewers and manholes, naturally become standardized until a commonly accepted standard design is copied from one project to another without thought of change. Presumably such standards embody the best ideas of all previous designs and are more likely to be satisfactory than any one engineer's design made regardless of the ideas embodied in such standards.

This, however, should not be accepted as meaning that the standards of today can not be improved upon; and it is desirable to consider improvements suggested from time to time with a view to possibly modifying the standard. An excellent method of doing this is to compare the standards generally accepted in this country with those which have been developed more or less independently in another. Such an opportunity in connection with manhole design is offered by an article on the subject by an English engineer, L. B. Escritt, published in the English journal "The Surveyor." The essential features of this are abstracted below, and the author's illustrations are reproduced.

Manholes may be considered of two main classs: simple manholes for general use on small sewers; and special manholes, including those for large sewers, side-entrance manholes, back-drop manholes, cascades or tumbling bays, pressure manholes, etc.

Manholes for small sewers consist of a chamber about 3'x4'6", with a roof at least 6 ft. high above the highest part of the bench if possible, above which is an access shaft 2'3" square if of brick, or in diameter if of concrete. Ladders in the shafts are preferred to steps; they cost more initially but are more easily renewed, being bolted to the walls with non-corroding bolts. Very deep manholes should always be broken by platforms at intervals of about 20 ft. (See Fig. 2).

Precast concrete manholes are popular. They usually consist of rings of two sizes, large rings for the chamber at the bottom and smaller ones for the shaft, with an intermediate taper piece connecting the two.

The bottom is made, as in this country, with a concrete slab containing the invert, with a bench on each side level with or slightly above the crown of the outgoing sewer, and sloping about 1:6. That shown by A Fig. 1 is too low and flat to keep clean; that shown by B does not give a safe foothold. "Precast inverts and benchings finished complete may be obtained from the manufacturers of concrete tube manholes."

Manholes for large sewers are designed to permit men to enter the sewer and as a means by which detritus may be removed or building materials for repairs taken in. Men should be able to escape quickly or be rescued easily in case of emergency. The ladder should not lead directly to the invert, but to a platform above it (Fig. 3) or a side entrance (Fig. 4). The latter is preferably from the point of view of safety and is preferred by the Ministry of Health, but is more costly and may be dirty. Where there is much street traffic, access shafts are placed under the sidewalks, with galleries leading from them to the shafts or side entrances of the sewer. Safety bars and chains are recommended on all platforms and on the outgoing side of manholes on large sewers.

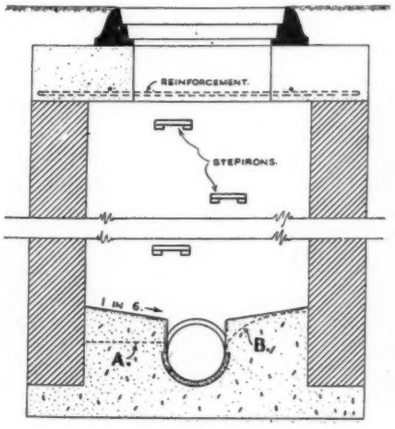
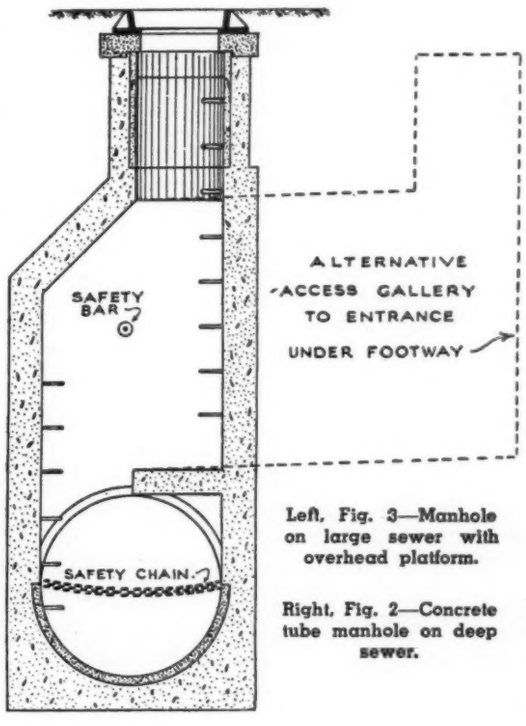
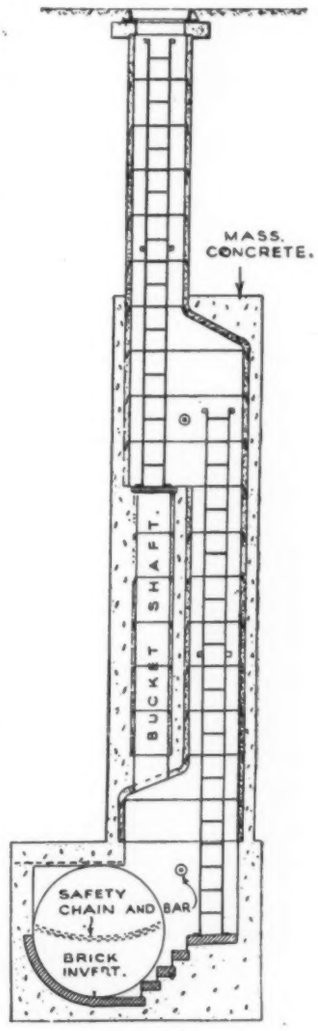


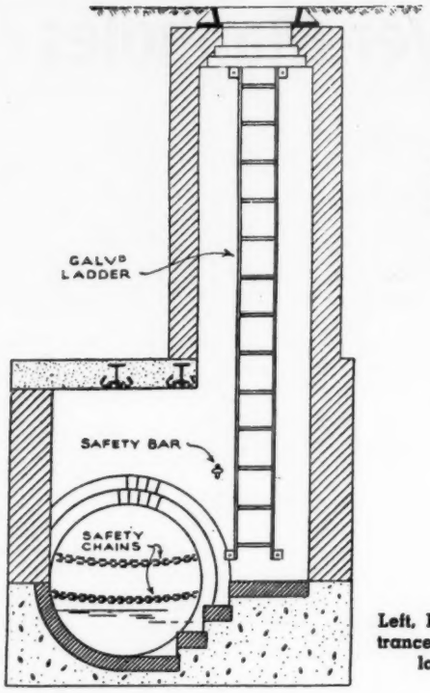
Fig. 1—Manhole for small sewer.



Left, Fig. 3—Manhole on large sewer with overhead platform.



Right, Fig. 2—Concrete tube manhole on deep sewer.



Left, Fig. 4—Side entrance manhole on large sewer.

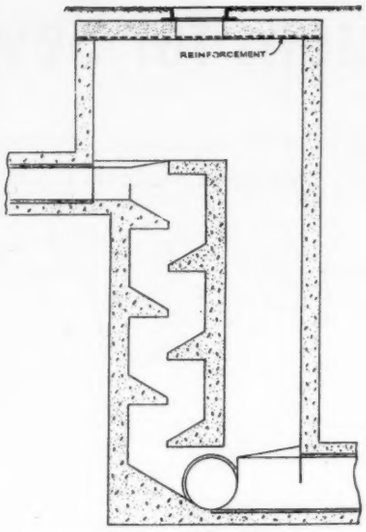
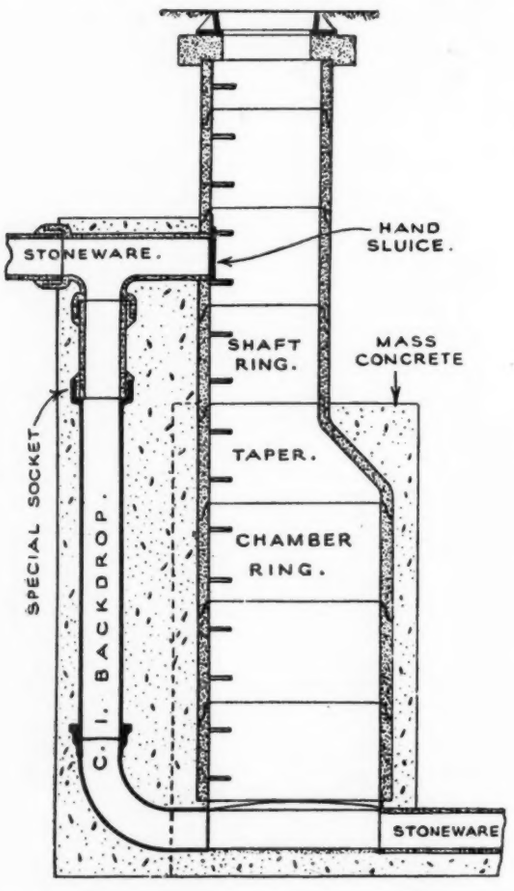


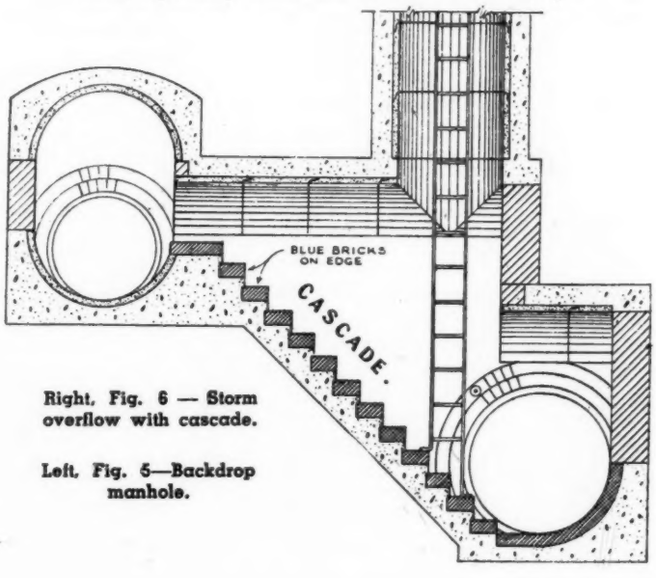
Fig. 7—Vertical cascade.

In connecting a sewer to another at a lower level a back-drop, cascade or tumbling bay is used. The first causes excessive scour at the foot of a high drop. (Twenty feet per second is said to be the scouring velocity of concrete.) To prevent this, the fall can be broken up by a series of steps, or materials that do not scour easily can be used, or a water cushion provided at the bottom. Where the sewers are small and the drop does not exceed 3 ft. it is common practice to use a vertical pipe terminating at the lower end in a heavy cast iron bend or in a trap to act as a water cushion. For large flows, the cascade is preferred, with steps sufficiently deep so as never to be completely submerged but not deep enough to permit high velocities; 8″ x 8″ is suggested as serving as a stairway for sewer workers. If the flow is very great the cascade may be made wide. If the drop is very deep, the design shown in Fig. 7 may be used.

As to materials of construction, dimensions, etc., Mr. Escritt says: "The writer holds that a proportion of the manholes constructed of comparatively recent years are unnecessarily strong, and that some engineers are afraid of practice which others have, over long periods of time, found to be satisfactory." In designing the thickness of walls of manholes, he would consider flat walls of rectangular chambers or shafts as beams, and design them to take the soil and water pressure due to their depth below the surface, using a safe tensile strength of about 60 lb. per sq. in. He gives a table of thickness based on this theory, the wall thickness varying from 1/6 the length of side at 16 ft. depth to 1/3 at 64 ft. For round shafts he gives thickness equal to 1/12 the diameter down to 10 ft. depth, 1/10 for the next 10 ft., 1/9 for the next 10 ft., etc. But no brickwork or mass concrete should be less than 9″ thick and no reinforced concrete less than 3″ thick. Reinforced concrete generally is an unnecessary refinement for manholes of normal proportions; the necessary strength can be gained more easily and at less cost by added thickness of concrete. This, however, does not apply to roof slabs.

When precast concrete rings are used it is usual to surround part of the work with mass concrete. In one design which has never failed, the manhole is surrounded with concrete to the level of the top of the taper piece but not above this, the concrete either having a minimum thickness or filled to the sides of the excavation; but some carry the concrete up to the surface, especially where the street traffic is heavy.





Right, Fig. 6 — Storm overflow with cascade.

Left, Fig. 5—Backdrop manhole.

The Editor's Page

Sterilizing Newly Laid Mains

Most cities now chlorinate their water supplies, this in many cases supplementing filtration, in an effort to deliver to the distribution system water that is free from all bacteria, especially coliforms, as well as from all polluting matter. And yet a surprisingly large number of them knowingly, although perhaps unthinkingly, pollute this water after it enters the system. In our August issue we told of one large city which reported that water practically sterile when it left the plant showed coli in large numbers in the tap water in districts where new mains had been laid or vital repairs made. The cause was realized—it was due to placing in the distribution system pipes or valves that had not been sterilized before being placed in service.

Unfortunately this is by no means a unique case. Data collected by us from several hundred cities and reported in this issue indicate that at least a third of the cities throughout the country fail to sterilize newly laid mains. Why this is so it is difficult to understand; especially why, in one of the states supposed to be especially advanced in public sanitation, 68% of the cities reporting state that they do not take this precaution.

A moment's thought must make it evident that mains and valves that have been exposed in transit, in days of lying on the street subject to contamination by cats, dogs, boys and men, by street dust and dirt and gutter water, and by handling and water and dirt from the trench while being laid, are almost certain to contain matter that should not be permitted in a water supply. The dangers of this practice and methods of eliminating them have been discussed frequently before water works societies, and yet many superintendents continue to serve to their consumers matter which, even though small in amount, is certainly polluting and possibly pathogenic.

Annual Reports, Statistics and Soporiferousness

About this time of the year, in most cities, counties, water departments, sewage treatment plants and other governmental establishments, there are stirrings in preparation for annual reports.

Preparing such a report usually involves bringing together not one statistic, but a large number of them. Now a statistic is a fine thing, if used properly. In general, it should not be used to fill a report with, thereby accomplishing a rather costly burial in a set of already overloaded archives. Rather it should be dissected and digested in order that its meaning may be brought out where the taxpayer can understand and appreciate it. If it is not so presented, it is of little use, no matter what its inherent value.

To avoid sleepiness, lack of attention and absence of interest in your annual report on the part of John Q. Public, interpret your statistics for the layman; use them in exceeding moderation; garnish and decorate them with simple and understandable charts and diagrams; and add a seasoning of human interest in terms of how the matters discussed affect the welfare of the citizens.

Making Conventions More Worth While

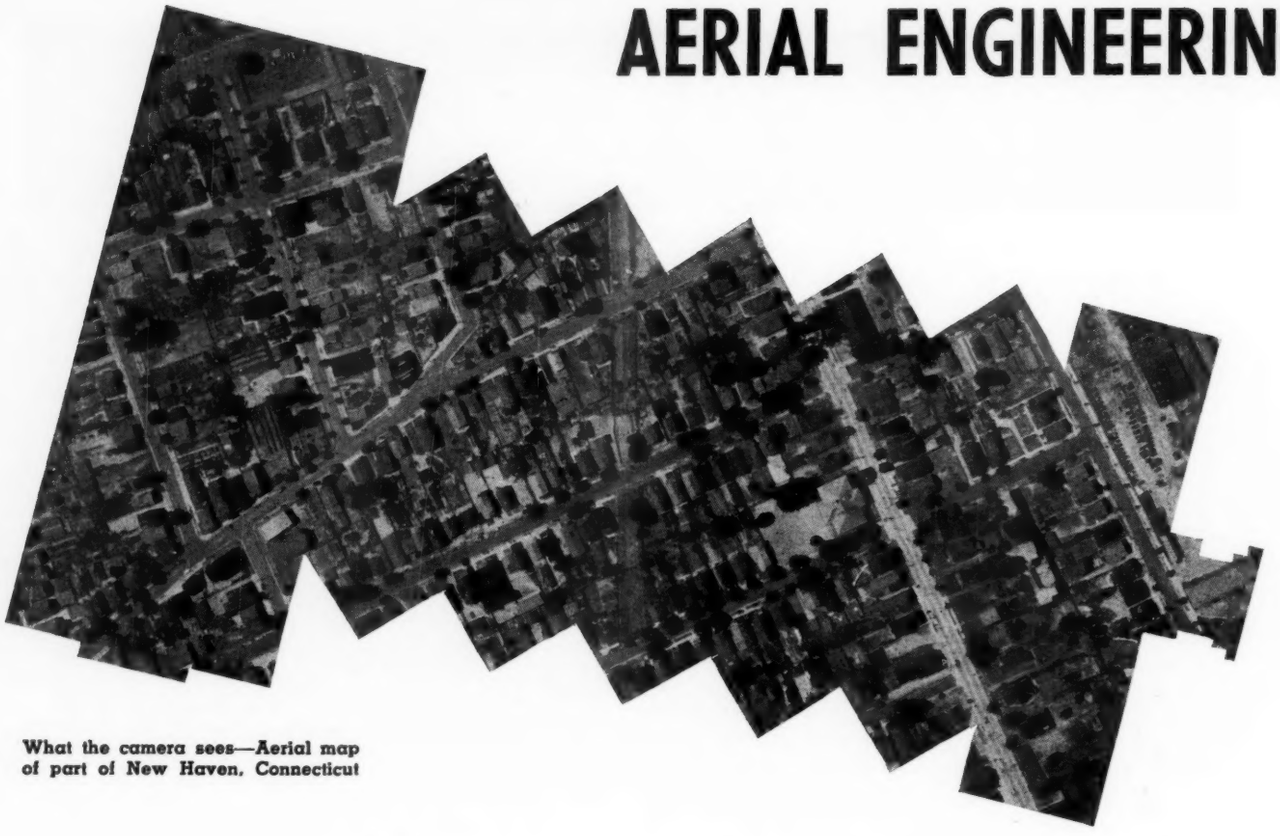
For most technical associations, whether it be sewage works, water, highway or other, it is a continual struggle to increase or even to maintain attendance at their annual meetings. Editors of technical magazines are in continual receipt of appeals for publicity or for special work to help increase the attendance. These appeals do not generally fall on deaf ears.

The solution to the problem, however, does not lie solely in increased publicity. It lies, still more, in giving the convention-goer an adequate return for the expenditure of his time and money. We believe that this can be done through the establishment of a soundly planned and carefully carried out school designed especially for the younger and less experienced men, especially those from the smaller communities. It is a frequent complaint that these men will not attend national conventions, because the communities will not pay their expenses to a convention, but this condition would largely disappear if the men and their communities were convinced that there would be a return on the money spent. With all due regard to the excellent exhibits at our conventions, looking at them does not usually give any big return on an expenditure of fifty or more dollars. As for the papers, too many of them are over the head and beyond the interest of any but specialists along certain lines.

The editors of this magazine believe that a carefully planned and properly carried out instruction school, in connection with such conventions, would materially increase attendance eventually. With the resources available in personnel, training and experience among its members, a national association should and could set a standard in such instruction that would be of immense benefit to the numerous successful short schools now being operated by some of the state health departments, and also cover subjects not handled by them.

The surface has not been scratched, so far as providing the best instruction material in such schools. Numerous engineers and manufacturers with whom this has been discussed have suggested ideas of a highly practical and valuable nature, which could be worked out and applied, with great benefit, to groups from smaller communities. Trained teachers are also available who will be glad to give of their time and energy, if it will benefit others. There is now a greater than usual demand for more knowledge on the part of those whose previous training has not included technical phases. There is no better way to obtain the interest and cooperation of the members of any profession than by helping them to become more efficient.

AERIAL ENGINEERING A



What the camera sees—Aerial map of part of New Haven, Connecticut

AERIAL engineering, aerial photographic surveys, and precise contour maps made from aerial photography maps are not new to the profession of public works. The Port Authority of New York has used them in its study of harbor development; the Greater Motorways System of Erie County, New York, found them indispensable in its study of "bottlenecks," types and approximate values of land, the securing of cooperation from property owners in obtaining rights-of-way, reconnaissance information in regard to grading and filling; The Technical Advisory Corporation of New York City used the medium for municipal planning and zoning; the Board of Water Commissioners of Hartford, Connecticut, were more than satisfied with the results proved from aerial photographic surveys in their study of slopes, feeders, approximate flood lines, sources of pollution, and similar types of public works information. And these are to mention but a few of the very many the country over.

Let us take an hypothetical case, which for the purposes of the story will be an extreme case. A large corporation plans to establish a community around a to-be-built factory in the heart of the Amazon River Valley, where the territory has never before been mapped. In order to build the factory, lay out roads and railways, and effect proper drainage and sewerage, maps from which the engineers can study the construction problems in advance must be made available. Three sets of maps will have to be obtained: large mosaics of the entire territory for "office" engineering study, contact prints for the engineer to take into the field for ground orientation, and precise contour maps from which road and railway construction may be laid out and town planning arranged. Under such conditions the aerial photographic survey has been proved less expensive and more accurately effective than the conventional ground survey method.

The Solar-Navigator

Since this hypothetical territory has not heretofore been surveyed, pilot and cameraman have no known landmarks from which to fix triangulation points necessary to the formation of guide-flight lines over which the photographic exposures will be made. Therefore the plane should be equipped with a solar-navigator. The solar-navigator is a device developed but a few years ago which consists of a drift indicator in the floor of the plane stabilized by a gyroscope which counteracts the tendancy of ground images to meander over the drift field as the plane rolls. This drift indicator is suspended from a sun compass in the roof of the plane's cabin. The sun compass registers, by remote control, on a galvanometer on the pilot's instrument panel. The desired course is set and then the actual course over the ground is checked with parallel lines in the drift sight. When the drift sight is rotated so that images on the ground follow one of the parallel lines, it registers on the pilot's instrument panel, showing that the plane has veered from the correct direction. The operation of the instrument is automatic, dependent only on the adjustment by the navigator of the drift indicator so that ground objects on the ground glass of the drift indicator move accurately (parallel) along the drift lines.

This instrument will fly a plane down any predetermined course to an accuracy of one-quarter degree. With its assistance a plane may be started over any known control point, such as an astronomical station or a coast survey station; and from two such known points it is possible to carry triangulation far into the interior of, say, the Amazon River Valley where our hypothetical township is to be located. In this way, a triangulation net may be carried out by means of which a fairly accurate control will be established for our survey needs.

G AND PUBLIC WORKS

By HERBERT THAYER BRUCE

Aerial photographing for mapping purposes is continually being refined. One of the latest developments is the solar navigator, holding the plane to a predetermined course. Another is the stereoplanigraph. Both are described in this article, together with older standardized methods.

For control established by this means, the slotted template method is used, by which it is no longer necessary to depend on the matching of images in order to assemble a complete mosaic map; and reasonably accurate maps may be made without anyone setting foot within the territory.

Taking the Photograph

Before explaining the making and the application of mosaic and precise contour maps and the stereoscopic study of contact prints, it is best to know how these individual photographs are taken in successive overlapping strips.

The camera is installed in the plane with the lens pointing downward through a hole in the fuselage. The elevation at which the plane must be flown is determined by multiplying the scale at which the terrain is to be mapped by the focal length of the lens to be used. Thus, if the scale is to be eight hundred feet to the inch and a lens of twenty inches focal length is to be used, the altitude above the terrain (not above sea level) must be (800 x 20) sixteen thousand feet. The pilot outlines on geographical survey sheets the area to be covered and determines the guide or flight lines to be followed; then flies along these guide-flight lines, back and forth, forming strips of overlapping exposures until the required area has been covered. However, because of the overlap, the net effective area of each exposure is about one-fifth of the total area of that exposed. Accordingly, the photographer times the consecutive exposures so that they overlap each other shingle-wise by about sixty per cent and the pilot plots his guide-flight lines so that the strips overlap each other by about fifty per cent. Thus each object on the terrain is photographed five times. The overlap makes it possible to use only the center portion of each photograph, which is the only true vertical projection. Discarding the edges of the photographs in making the map also avoids a certain amount of displacement of elevated ground objects due to conical projection caused by

Aerial map of part of Providence, R. I., Scale about 1100 feet to 1 inch

the diverging lens rays. The overlap, moreover, allows the stereoscopic study of the terrain which adds the third dimension, or perspective, to any portion of the ground area covered.

Making the Mosaic Map

Roughly, there are five steps in the making of the mosaic: scale ratio is carefully figured by checking comparable distances on developed contact prints with known distances on the actual terrain (the slotted template system being used when known objects on the terrain are unavailable). Inaccuracies due to the side-slip of the plane due to drift or wind velocity are thus determined. Each print is then projected to a common accurate scale. Control lines are drawn to the desired scale of the map on a composite board, the control being triangulation points either from astronomical readings when the use of the solar-navigator has been necessitated, or from field notes, road maps, etc. The corrected prints are then cut along lines determined by the physical type of terrain—streams, acreage rectangles, road intersections. They are then cemented onto the composite board over the corresponding control lines. This master mosaic is then copied, rephotographed, and prints made from the copy negatives are matched together to make the complete mosaic. However, the complete mosaic is not delivered to the client, he receives copy prints, which are photographs of sections of the mosaic, each generally twenty inches by twenty-four. It is these copy prints which may be enlarged (an individual negative at say eight hundred feet to the inch may be enlarged to two hundred feet to the inch without appreciable loss of definition) for stereoscopic study, or which may be made into a complete mosaic for office engineering study.

Stereoscopic Study

The stereoscope used to study these prints is a reflecting two-mirror device which makes it possible to view, at one time, two pictures, portions of which cover the same ground area, but taken at slightly different angles. The ground area common to both pictures is transformed to a three-dimensional plastic model, in which hills and valleys appear in relief. The making of the precise contour map by aerial methods known as photogrammetry, is a more technical procedure than any thus far described, and, though practiced some quarter century past, has only recently been accepted for engineering use.

Any two overlapping aerial photographs having a common area, taken successively as the plane flies its guide-flight lines, can be viewed through the stereoscope so that one eye sees one picture and the other eye the other picture, the eyes following the same angular paths that two transits would follow were they placed in the same positions as those of the cameras when taking the pictures. When one's eyes converge, the brain registers that that object is closer, when they diverge, that it is further away.

The stereoplanigraph, of which it is said that there is but one in existence in this country is a stereoscopic plotting machine which replaces the two images in miniature, as they were at exposure. The exact angle and elevation of each picture is reproduced at the small scale of the stereoscopic model. While viewing the picture stereoscopically, an index mark is provided which is so mechanically articulated by the machine that it can only appear to move in a single horizontal plane. This index mark appears to float in the air if over a canyon or to bury itself in the ground if against the side of a mountain. The operator, therefore, can tell exactly when the index mark is in precise contact with the surface of the ground. By operation of two hand wheels, the operator causes this index mark to follow a contour line, which the machine draws on paper. Maps can be made by this means to any desired degree of precision; scales may vary from as large as one inch to twenty feet to as small as one inch to two miles. A minimum skeleton of control points is necessary for its preparation; a map at a scale of one inch to one thousand feet will require a known control point, for instance, for each square mile of territory.

Such a survey and photographic map mediums are practical not only for laying out a town site, but also for such projects as the extension of a sewerage system, the selection of watersheds, the rerouting of traffic during highway construction, or the carrying of transmission lines cross country. A right-of-way may be surveyed and its purchase price estimated without the owner being aware that his particular strip of property is being considered for acquisition. For who is concerned with what an airplane is doing while flying overhead? But surveyors in the field give themselves away. Also, from such a map, types of soil may be learned by study of brush growth; rock outcropping, blow-downs, swamps and river flood lines may be defined, grouping of coniferous and deciduous trees distinguished.

Cost of Such Survey

All this sounds expensive. But while New Britain, Connecticut, with an area of thirteen square miles, was surveyed by ground methods over the course of four years at a cost of $48,000, Middletown, Connecticut, with an area of forty-two square miles, was aerially surveyed within sixty days at a cost of $4,000. "The aerial maps gave the entire municipality in one hundred per cent detail, showing every building, tree, curbstone and stone wall to scale." A water and power company in Pennsylvania estimates in surveying a 150-mile transmission line that "about one-half the cost of surveying has been saved by aerial maps. No preliminary surveys were run in the field. The alignment was practically fixed in the office on the map."

Yet, the cost of an aerial map, whether it be a photographic map or a contour map, cannot be estimated with any degree of general accuracy, since seldom are there two projects with sufficiently similar conditions to justify even a rough comparison. Any kind of an aerial map is dependent on many factors. Distance away from an operating base, for instance; weather conditions; scale of map necessary; precision at which the map is to be made . . . these and many more. Therefore, it is advisable to accept the testimony of past users to the effect that the medium is less expensive than conventional ground methods and even more satisfactory, wherever the location and whatever the purpose. Whatever the survey problems of the public works engineer for whichever of his construction needs, here is an additional right arm with which he cannot well afford to dispense. and year by year aerial engineering becomes more generally useful through scientific advancement.

Garbage Is What?

Defined as discarded food or kitchen wastes, garbage would seem to be a composite of quite a variety of objects; a number of cities and states have given it an even more comprehensive legal meaning; but California seems to have gone about the limit. According to a 1939 act of that state, "The term 'garbage' as used in this act, shall include . . . anything thrown away as worthless"—such as baby carriages and old tin roofs.

Blading aggregate into windrows

Distribution applying oil

Eliminating DUST Reduces MAINTENANCE COSTS

MANY of the roads of King Co., Wash., were originally of gravel, which contained considerable clay, and was dustyin dry weather. A bituminous surfacing program is being carried out which is providing a system of hard-surfaced roads and also reducing maintenance costs. Construction is in three stages.

The first stage usually consists of blading the existing surface to a uniform road section by means of a heavy road grader equipped with scarifier when necessary. All loose surface materials are then bladed into windrows along each edge of the road and the surface swept free of dust and dirt. A pressure distributor then is employed to apply a shot of SC No. 2 at the approximate rate of 0.5 gallon per square yard. Immediately following this, the material in the windrows is bladed over the freshly treated surface and broomed until sufficiently set against raveling under traffic. The surface is then further compacted by means of a modern power roller.

The second treatment consists in patching and leveling the first course, placing a light shot of MC No. 2 oil, about 0.25 gallon per square yard for a tack coat. At the rate of about 100 cubic yards to each mile of 20-ft. road, a layer of ¾-inch minus crushed rock aggregate is spread over the roadway surface. During this stage, traffic is not excluded from the highway, and after a minimum of five days, during which period rubber-tired patrol graders keep the surface evenly covered, a second course of oil and rock aggregate is spread in the same manner as for the first layer.

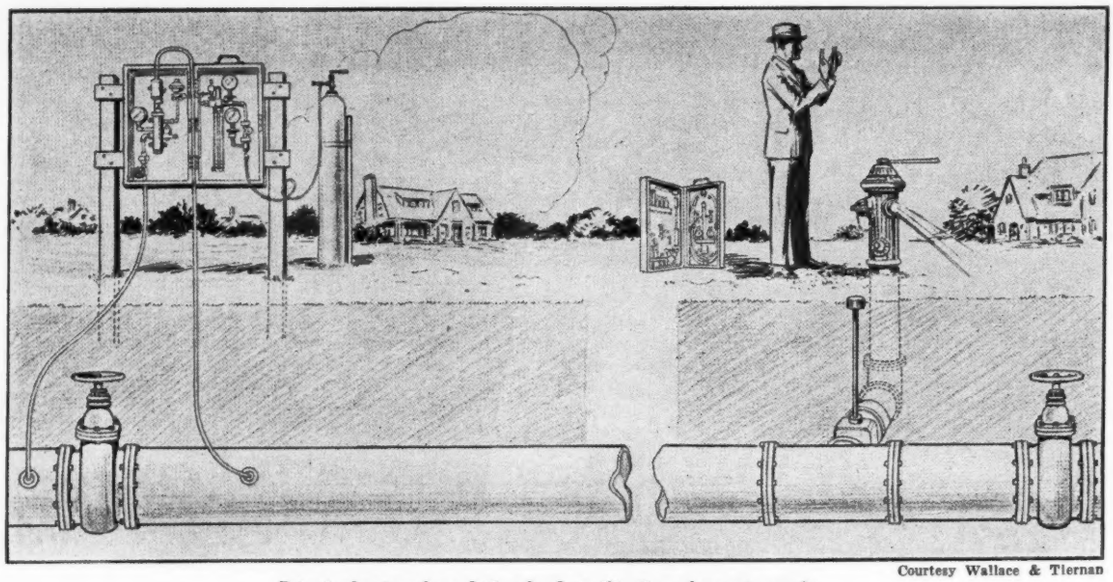
The final treatment consists in patching and leveling the roadbed, and brooming the surface until clean; then a pressure distributor is employed to apply the seal coat, using RC No. 4 at the rate of 0.30 gallon per square yard. This application is then covered with coarse screenings ½ inch to ¼ inch at the rate of about 150 cubic yards to the mile. The surface is then compacted to a uniform section with a ten-ton roller, remaining voids being filled with a spread of fine screenings ¼ inch to No. 10, at the rate of 50 cubic yards to the mile. The last application of the fine screenings produces a dense mat, giving a smoother, non-skid surface, impervious to moisture—a distinct benefit in this country.

The cost of construction averages about $2125 per mile, but varies greatly due to local conditions. Since this surfacing program has been under way, maintenance costs have decreased, being $75,000 less in 1938 than in 1937.

H. H. Sisler is county road engineer.

Distributor spreading oil

Truck with spreader box, spreading crushed rock



Courtesy Wallace & Tiernan

A typical set-up for solution feed sterilization of a water main.

Methods and Practices in Sterilizing Newly Laid Mains

WATER pipes which have been lying for days or months on the ground or in the stock piles before being laid are certain to contain dust and dirt of various kinds, more or less of which is likely to contains dangerous bacteria. Instances are on record of typhoid epidemics caused by bacteria from newly laid mains which had not been sterilized before being placed in service and it is now recognized that such sterilizing is necessary if a safe water supply is to be assured.

To learn how general the practice of sterilizing mains has become and the methods employed, we questioned water superintendents throughout the country and have received replies from 363. Of these, 243 reported that they sterilized new mains, but 120 that they did not do so. An additional 123 cities which returned the questionnaire failed to answer this question and it is probable that a still larger percentage of these are remiss in this respect. That a third or more of the cities fail to take this precaution seems to indicate need for further education in this matter.

Detailed information from each state is shown in the accompanying table. Information from several of the cities as to methods and procedure are given later in this artilce.

The three principal methods of procedure used are: (1) to apply liquid chlorine through a special chlorinator, or sometimes directly from a cylinder; (2) to place hypochlorite in the pipe while the line is being laid, and allow the water as it enters to make the solution; (3) to inject a hypochlorite solution into the mains. In any case, he should insure a heavy residual chlorine in the water in the main, and this heavily chlorinated water should remain for at least 24 hours to insure sterilization. In general, a chlorine application of about 50 p.p.m. is desirable.

When liquid chlorine is used, a corporation cock is inserted in the old line near the point of connection with the new, and a special stuffing box inserted and connection made to a chlorine cylinder with a silver or copper tube. (These stuffing boxes and special tubes can be obtained from most manufacturers of chlorinators, who can also furnish special chlorinators for the purpose.) After the connection between the old and new lines has been made, the new line is flushed out thoroughly, and then drained. Water is then turned into the line and chlorine gas from the cylinder is turned into the main. Orthotolidine tests are made of the water as it flows out of the valve or hydrant at the lower end of the line. When a strong red color is shown

PRACTICE IN REGARD TO STERILIZATION OF MAINS BY STATES

State	*Yes*	*No*	*State*	*Yes*	*No*
Alabama	2	—	Nevada	1	1
Arkansas	3	—	New Hampshire	2	—
California	13	7	New Jersey	8	8
Colorado	1	4	New Mexico	1	—
Connecticut	7	1	New York	20	8
Florida	3	2	North Car.	4	3
Georgia	3	1	North Dakota	1	—
Idaho	—	1	Ohio	14	16
Illinois	17	2	Oklahoma	3	—
Indiana	8	2	Oregon	4	—
Iowa	13	2	Pennsylvania	15	9
Kansas	2	4	Rhode Island	2	—
Kentucky	3	2	So. Carolina	3	1
Louisiana	2	1	So. Dakota	4	2
Maine	4	2	Tennessee	4	1
Massachusetts	8	17	Texas	9	—
Michigan	11	8	Utah	1	—
Minnesota	6	2	Virginia	3	—
Mississippi	4	1	West Va.	4	1
Missouri	7	—	Wisconsin	15	6
Montana	2	1		243	120
Nebraska	6	4	Not answering		123

by the test, the line is allowed to fill; then the chlorine gas is shut off, also the valve admitting water to the new line. The chlorinated water is then allowed to stand in the line for at least 24 hours, after which time it is flushed out. If there is no valve or hydrant at the lower end, a testing plug can be fitted with a stop cock, which performs the double duty of permitting the discharge of air from the line and of allowing samples to be taken. Water pressure in the line at the time of applying chlorine should not generally be greater than 30 pounds.

When using a hypochlorite solution, the same general method is followed, except that a solution feeder that will apply the solution against pressure is required.

When hypochlorite has been placed in the pipe line as it was laid, the lower end of the line is plugged or the valve or hydrant is shut off and the line is allowed to fill very slowly. Consideration must be given to pipe line capacity, and to the strength of the hypochlorite used. Ordinary bleaching powder contains about 25 per cent of available chlorine; HTH or Perchloron are high-strength hypochlorites, which contain about 70 per cent available chlorine, and only about 40 per cent as much is needed. The American Water Works Association recommends 1 pound of the high-strength chlorine to each 1680 gallons of pipe line capacity, which is at the rate of 50 p.p.m. of chlorine.

When using bleaching power with 70 per cent available chlorine, the following approximate amounts are required for each 100 feet of pipe line: 4-inch, about ¾ ounce; 6-inch, 1½ ounces; 8-inch, 3 ounces; 10-inch, 4 ounces; 12-inch, 6 ounces; 16-inch, 12 ounces; and 18-inch, 15 ounces. When using bleaching powder with 25 per cent available chlorine, use about three times as much. In this connection, it is interesting to note that, though the question was not asked, about one-third of the superintendents replying volunteered the information that they used the higher strength bleach (83 specified HTH, 10 Perchloron, 19 liquid chlorine, and about 25 "hypo.").

A dry feed chlorinator is used to feed chlorine gas direct into the main in Pittsburg, Calif., R. L. Heck, Superintendent, Municipal Filtration Plant. The Water Bureau of the Metropolitan District of Hartford, Conn., Caleb Mills Saville, Manager and Chief Engineer, places about a handful of high-strength

A typical example of pollution of a new main by dirty trench water.

Chlor-O-Feeder main sterilizer.

chloride of lime per 100 feet, the pipe line is filled, allowed to stand for at least 24 hours, and then flushed until there is no trace of chlorine remaining. In Jacksonville, Fla., O. Z. Tyler, Superintendent, Electric Production and Water Department, about a handful of HTH is placed in each length of pipe as it is being laid. After filling and standing, the lines are tested bacteriologically and if found unsatisfactory, are then treated with a portable chlorinator.

In East Peoria, Ill., J. R. Boundy, Superintendent of Water Works, either of two methods may be used: HTH is placed in the pipe dry, or a solution of it is injected into the main by means of a force pump. In Elgin, Ill., E. B. Lloyd, Chief Engineer of the Water Department, adds enough hypochlorite, when repairs to a line have been made, to give a residual of almost 1 p.p.m. in the contiguous segregated section. Charles Brodbeck, Superintendent of the Water Department, Decatur, Ind., says: "I use HTH for sterilizing new mains. All there is to do is to put a very small quantity in each length of pipe; when the laying is completed, close the valve at the lower end and let water into the line very slowly so as not to wash or flood all of the bleach to the lower end. Allow to stand several hours; then flush lines thoroughly until all milkiness disappears."

A residual of 50 p.p.m. is developed in Nappanee, Ind., B. A. Uline, General Manager, reports. J. F. Bradley, Chief Engineer, Department of Water Works, Valparaiso, Ind., says: "The approximate capacity of the pipe (repairs or new mains) is calculated and chlorine solution to give a dosage of 50 p.p.m. is pumped into the main, which is filled slowly. Water is wasted at the lower end until there is a distinct odor of chlorine. The main is then closed off and allowed to stand for 24 hours, if possible. Water is then drawn off through a hydrant or corporation until a residual of not more than 0.20 p.p.m. is obtained, when the main is put into service."

Hypochlorite is used in Cedar Rapids, Ia., H. F. Blomquist, Superintendent, except with long lines of pipe, in which case liquid chlorine is used, being introduced into the water when the pipes are first filled. After 24 hours, the lines are flushed out. Warren McCormick, Superintendent, Osceola, Iowa, uses HTH, placing about a teaspoonful at each joint when the line is laid. When the line has been completed, the water is admitted very slowly, allowed to stand for 24 hours,

AMOUNTS OF DRACKETT CHLORINATED LIME, AND OF H. T. H., REQUIRED FOR STERILIZING VARIOUS SIZES OF WATER MAINS—BASED ON DOSAGE OF 50 PARTS PER MILLION, CHARLESTON, S. C., J. E. GIBSON, MGR. & ENGR.

	DRACKETT = 24%			H. T. H. = 65%		
Pipe Size Inside Diameter	*Pounds per 100 ft.*	*Length per Ounce*	*Length per 6 Oz.*	*Pounds per 100 ft.*	*Length per Ounce*	*Length per 6 Oz.*
4"	0.1135	53 ft.	318 ft.	0.0419	144 ft.	
6"	0.256	24 ft.	144 ft.	0.0943	64 ft.	
8"	0.453	13 ft.	78 ft.	0.167	36 ft.	
10"	0.71	9 ft.	54 ft.	0.262	24 ft.	
12"	1.023	6 ft.	35 ft.	0.377	16 ft.	96 ft.
16"	1.818		22 ft.	0.670		60 ft.
20"	2.84		13 ft.	1.05		36 ft.
24"	4.09		9 ft.	1.51		24 ft.

H.T.H. case contains 1 doz. 4 lb. cans—65% Available Chlorine.
Drackett Hypo. Case contains 1 doz. 12 oz. cans—24% Available Chlorine.

and then flushed out two or three times, about 36 hours between flushings. S. S. Anthony, Superintendent and Engineer, Augusta, Me., Water District, uses hypochorite for large mains, placing a small quantity in each length; but on small mains, a hypo solution is pumped in.

Mains are sterilized by means of a portable chlorine gas drum feeding direct into the main until repeated tests show there are no Coli present. S. J. Shank, Superintendent, Escanaba, Mich.

J. A. Jensen, Water Works Engineer, Minneapolis, Minn., writes: "When mains are opened, connected to, or repairs made of breaks, hypochlorite of lime (HTH) is placed inside before making up joints at closure. Water is admitted and the main kept out of circulation, if possible, until sampling is done for residual chlorine. On important work, bacteriological analyses are made. Prior to putting main back into service, it is flushed thoroughly." The Metropolitan Utilities District, Omaha, Nebr., T. A. Leisen, General Manager, uses a portable chlorinator applying liquid chlorine.

In Fair Lawn, N. J., Frank Knapp, Water Superintendent, uses bleach, generally high strength, placing about 2 ounces in each length, filling slowly with water, standing overnight and flushing. If service connections have been installed at the same time that the main is laid, the same procedure takes place, and the heavily chlorinated water is forced out through such connections so as to make them safe also. Herkimer, N. Y., C. Leland Wood, Superintendent, uses both or either hypochlorite or liquid chlorine, following usual practices already outlined. Syracuse, N. Y., E. P. Stewart, Division Engineer of Water, uses a portable chlorinator. Akron, O., W. R. LaDue, Superintendent and Engineer, checks results after sterilization by bacterial tests. Providence, R. I., sterilizes new mains with HTH solution, in proportion to rate of flow, through a portable chlorofeeder. Dose is 50 p.p.m.; main is flushed, checked bacteriologically and subjected to another treatment if necessary.

Liquid chlorine is used in Reading, Pa., to give a dosage of 50 p.p.m. and the line allowed to stand for 12 hours. Howard McDonough, Director, Department Parks and Public Property. A portable chlorinator is used in Racine, Wisc., W. A. Pierce, Manager of the Water Department, and the water before use is checked bacteriologically so as to meet Treasury Department standards.

More than a hundred other superintendents and engineers gave us data on their practices in this regard. In order to save needless duplication of information only a few samples of each method were chosen for publication.

Sand Hog Box Speed Sewer Construction

(Continued from page 16)

Prendergast, sewer and water superintendent, devised a "box" to be dragged by the ditching machine, in which the pipe layers could work safely, and which would prevent the banks from caving in.

The "sand hog box" was used in this manner: the trenching machine cut a ditch to the required depth, while a crew of men spudded on each side to maintain stable banks for the short time the trench was open. The end of the digging boom dragged the box by means of two channel beams into the newly dug part of the trench. Inside the box, the sides of which are of sheet metal, workmen shaped the bottom to receive the pipe at grade and mortared the joints. Two dump trucks received the earth from the delivery belt of the trenching machine and dumped it at the back of the box, keeping the trench constantly backfilled. Working in this way, from 200 to 400 feet of sewer were laid in an eight-hour shift.

By solving the problem of economical trenching in the sandy soil the greatest obstacle was overcome, but other difficulties arose to harass the WPA officials directing the job. It was found, for example, that every foot of sewer tile not loaded down with several feet of backfill was floated from 18 to 20 inches out of grade when it stood overnight. This made it necessary to spend an hour or two each morning on the difficult task of getting the last laid lengths of tile back in place. To prevent these delays it was decided to work on the trenching 24 hours a day. Lights were installed on the machine and in the "sand hog box," work continued night and day and no further interruptions occurred.

WPA workers built concrete manholes, the lower sections being precast and used as caisson bells. The upper sections of concrete were added as the excavation proceeded to the required depth. The sewer lines were then sealed into the concrete base. All forms were of wood with sheet metal lining and were used from 30 to 40 times.

By use of these methods, despite the problems which hampered the work, the job was accomplished at a cost that compared favorably with that of private construction; in fact, several contractors told WPA officials that, had they developed the sand box, they would have saved thousands of dollars on their own work in similar soil.

A booster pumping station has been required by the topography in order to elevate sewage from the east portion of the new town site and avoid an expensive lowering of grade for the main sewer over a distance of a mile. Steel sheet piling was driven and a reinforced concrete tank and pumping station was built.

Courtesy Caterpillar

Snow wings on motor grader cut back banks on rural road.

Equipment Used in Snow Removal and Mileage Cleared

CLIMATIC conditions, of course, combined with mileage to be kept open, determine how much and what kind of snow removal equipment any state, county, or city should have availble. Few data are available to judge, for any given locality or condition, how many plows, trucks, tractors, loaders and other equipment are needed. Rarely does the engineer have enough to meet above-average storms, though a few of the engineers named below feel that no additional equipment is needed in order to meet their needs.

In Escanaba Co., Mich., which plows 630 miles of roads, the following equipment is available: 12 heavy trucks, ranging from 6-ton to 12-ton, with snow plows; 9 lighter trucks, 1½-ton to 2-ton, with snow plows; 5 motor patrols; 2 tractors, 10-ton, with snow plows, these being rarely used. A little more heavy equipment could be used to advantage. J. T. Sharpensteen is Superintendent and Engineer.

For clearing 300 miles of roads in Geauga Co., O., there are available 6 speed plows, 2 V plows and 2 Baker plows, type not mentioned. This equipment is sufficient. As to amount of snow, J. Hinckley, Superintendent of Maintenance and Repair, states that during the winter of 1936-7, the plows were in almost continuous operation for 67 days and nights. Hendricks Co., Ind., Harold Cook, County Engineer, has supervision over 750 miles of roads. His equipment consists of 3 snow plows.

In Hardin Co., Iowa, the road system consists of 1,023 miles, of which 320 miles are in the trunk system and the remainder in the local system. An effort is made to open all these roads, but the least important are left until last, and those roads which do not have a farm on them until all others have been opened and there is time to tend to them. Equipment as reported by C. A. Boeke, County Engineer, consists of 11 patrols in various parts of the county; 2 large tractor plows—one for each half of the county—9 motor patrols with V plows and also with wings; 3 large (5-ton) truck plows and one 1½-ton one-way plow. This equipment is not quite sufficient for severe conditions.

Counties, by agreement, clear state highways in New York. In Dutchess Co., N. Y., the county keeps clear 580.37 miles of highway, of which 295.45 are state highways. Equipment includes 18 5-ton four-wheel drive trucks, one truck being equipped with an underbody scraper; 3 sand spreaders; 4 graders; 4 1½ ton trucks; 17 sets of Frink hydraulic snow plow lifts; 16 V plows and 9 straight blade plows (all Frink). Robert F. Knox is County Highway Superintendent.

Roads in Vernon Co., Wis., Clarence Hoff, Highway Commissioner, total 1000 miles. To care for these, the

Motor grader clears wide path on rural road in light snow.

county has 10 FWD 5-ton to 7-ton trucks, 2 4-ton (2-wheel drive) trucks and 6 1½-ton trucks, all equipped with plows.

Of the 324 miles of highways in Summit Co., O., which are cleared, 214 miles are gravel, 91 miles bituminous, 14 miles concrete and 6 miles brick. Arthur F. Ranney is County Engineer. Equipment includes 8 snow plows, 5 cinder spreaders, 3 salt spreaders and 2 rotary brush sweepers. Schenectady County, N. Y., W. W. Chadsey, County Superintendent of Highways, is responsible for snow removal on 308 miles of roads. For this work, there are available 6 tractors with rotary snow plows, 14 7-ton FWD trucks, 1 power grader, 5 4-ton to 6-ton trucks and 1 1½-ton truck, with suitable plowing equipment.

For clearing 1,350 miles of county road, ranging from highly improved to totally unimproved, Washtenaw Co., Mich., K. L. Hallenbeck, Superintendent and Manager, has 22 truck plows, 4 of them V type and 18 One-way; also two Caterpillar tractors with V plows on them. In Multnomah Co., Oregon, G. W. Buck, Roadmaster, about 500 miles of road are kept clear, using the following equipment: 1 Snogo Rotary, 1 roto blade for a FWD truck, 1 V plow for a 60 tractor, 2 V plows for motor patrols and 15 blade plows of varying sizes for trucks. Another rotary plow would be desirable.

In Lower Merion Township, Montgomery Co., Penn., there are about 140 miles of streets and highways. In addition to 16,000 feet of snow fence, the township has 14 snow plows. When storms are extreme, a snow loader is loaned from the State Highway Department to remove snow from the business sections. W. E. Rosengarten is Township Engineer.

Auburn, N. Y., with a population of 36,652, keeps clear about 86 miles of streets. To do the work, J. Francis Poole, Street Superintendent, has 6 plows that are attached to trucks—4 1½-ton and 2 3½-ton; also 2 Austin-Western "77" graders are used. This equipment is sufficient.

For keeping 85 miles of streets clear in Ann Arbor, Mich., Geo. H. Sandenburgh, City Engineer, has available 3 truck-driven snow plows, 2 under-body scraper plows, 3 one-man graders, 2 tractor-driven sidewalk plows and 14 horse-drawn sidewalk plows. In South Bend, Ind., Clyde E. Williams, City Civil Engineer, the Street Department has available about 20 dump trucks, 2 power graders, and 3 sidewalk tractors and plows.

About 120 miles of streets are kept clear in Augusta, Me., Waldo W. Hill, City Engineer. Equipment available includes: 1 Walter truck with Sargent plow and wings, with hyraulic controls; 1 Lombard tractor with Frink plow and wings, hydraulically controlled; 1 Mack truck with Sargent blade, mechanical controls; 1 Sterling truck with Good Roads plow and wings and hydraulic and mechanical controls; 1 GMC truck with Sargnet V plow and wings, hydraulic and mechanical controls; a Studebaker truck with blade and hydraulic controls; 1 International truck with Good Roads blade, hydraulic controls; 2 Warco Road Hog graders; 2 International sidewalk tractors and plows, one V and one blade. A snow loader would be advantageous for use in the business districts.

For keeping clear about 80 miles of streets in Fort Dodge, Iowa, J. L. Parsons, City Engineer and Street Superintendent, reports the following equipment; 6 trucks with plows and 1 grader. Leland L. Graham, City Engineer of Jamestown, N. Y., plows about 120 miles of streets, for which there are available 2 one-way plows, 2 one-man graders, 1 small tractor for clearing intersections, and a number of city trucks. LaCrosse, Wisc., clears about 118 miles of streets, using graders, tractors and truck-mounted plows; John Barth is City Engineer. Road machines and truck-mounted plows are used in Oil City, Pa., B. B. Webber, City Engineer.

Ice Control Practices

MORE and faster winter driving has made the ice control problem a "how" rather than a "shall." In other words, there is no longer a question as to the necessity of such work; how it can most effectively and economically be solved is to-day's problem. Herewith are given the practices now in use by a number of cities and counties.

Fort Dodge, Iowa, last year used about 12 tons of calcium chloride mixed with cinders and spread with trailer spreaders. This was found very effective. Au-

gusta, Me., uses either salt or calcium chloride or both, mixed with cinders or applied directly on the ice when there is a sudden freeze or sleet storm.

In the past, only cinders and sand have been used in South Bent, Ind., for icy intersections and similar danger points. Clyde E. Williams, City Civil Engineer, states that the city contemplates the use of calcium chloride and cinders, premixed and stockpiled, and applied as needed by means of a spreader.

Calcium chloride and sand are used in Ann Arbor, Mich., and both calcium chloride and salt in Marion, O. In Oil City City, Pa., cinders mixed with calcium chloride or salt are used to treat most hills and important intersections.

Auburn, N. Y., reports as follows: "We have three mechanical cinder spreaders to care for slippery conditions. We use a mixture of screened cinders and rock salt, varying according to the temperature from 50 pounds of salt to a yard of cinders to as much as 100 pounds per yard, more salt being added as the temperature falls lower. We find it most satisfactory to keep one truck loaded, with a driver and helper at hand to start out as soon as needed; then, if necessary, a second and a third can be started out later."

In LaCrosse, Wisc., salt is mixed with sand or cinders for ice control. Jamestown, N. Y., uses no chemicals — only cinders. Lower Merion Township uses cinders treated with calcium chloride, which are spread at intersections and other danger spots.

Sand and calcium chloride, 100 pounds to the cubic yard, are spread over the full width of roads in danger areas in Washtenaw Co., Mich. This county manufactured spreaders for applying abrasive before any were available commercially, and still finds these original units very efficient. Multnomah Co., Ore., states "we do not have much trouble with ice, but when we do we use salt to melt it."

Sand with either salt or calcium chloride is used for treating icy conditions in Schenectady County, N. Y. Vernon Co., Wisc., uses calcium and sand, and some salt. Hendricks Co., Ind., uses only cinder, without chemical. Geauga Co., O., uses both cinders and sand, treated with salt.

Ice control has been receiving serious attention in Dutchess Co., N. Y. Topographically this county is rolling, and the various localities in it are affected differently by the fall or rise of temperature. Therefore, no set plan can be applied to the county as a whole. At present, ice conditions are combated by the use of sand treated with calcium chloride and applied by means of spreaders.

Due to the fact that salt can be obtained at a low price from local mines, the salt-cinder combination has been used very largely in Summit Co., O. This has been found economical and effective; when cinders are not available, a sand-salt mixture has been used. Hardin Co., Iowa, has so far done relatively little in ice control, work having been restricted to treatment with sand or cinders of a few of the bad railroad crossings and a few of the more dangerous hills. Delta Co., Mich., treats sharp horizontal curves and steep grades with sand treated with calcium chloride.

These data are presented simply as a cross-section of practice in a number of fairly representative cities and counties in the snow belt. The use of chemicals with cinders or sand has generally been found to be more economical, because much less material is required, and also much more effective. Likewise, application by spreaders saves material and results in a more uniform and effective application of non-skid material.

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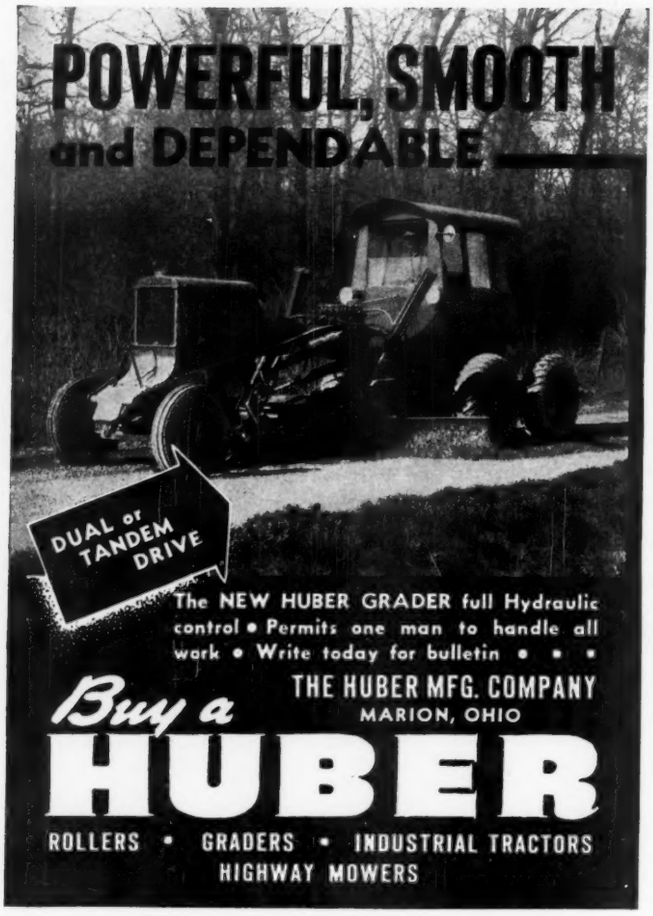
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Cathodic Corrosion Eliminators at Treasure Island

By CHARLES W. GEIGER

Among the many scientific exhibits at the Golden Gate Exposition on Treasure Island, an unusual and unintended one is an installation of twelve cathodic corrosion eliminators which have been installed to protect from electrolytic corrosion the 30 miles of water and sewer mains and 5 miles of gas pipes. The pipes were thinner than is customary since they were intended for only a few months' use; but failures began to occur in the domestic water system in less than 15 weeks after its completion. This, the last of the pipe lines to be installed, was completed April 10, 1938; the first leak was discovered on July 22, and by December 31 a total of 146 pipe line failures had been discovered.

Apparently immediate action of some kind was necessary and after conferring with the Engineering Dept. of the East Bay Municipal Utility District and the Pacific Gas & Electric Co., the Exposition Company arranged with Electrical Facilities, Inc., of Oakland, to install cathodic protection for the pipe lines.

This probably unprecedented rapidity of electrolytic corrosion was probably due to the nature of the soil in which the pipe was laid. The entire island was created by dredging sand and blue clay from the bay, and the pipe, passing through alternating deposits of these two materials, was subjected to thousands of galvanic couples, assisted by the corrosiveness of the salt water clay.

Iron Bacteria: A Correction and a Credit

We have received from M. K. Tenny, Assistant to the General Manager of the Des Moines, Iowa, Waterworks, some comments on the illustrations used in the article on "Iron Bacteria" in the October issue of PUBLIC WORKS. Five of these, he informs us, were taken from a paper written by him and published in the January, 1939, issue of the Journal of the A. W. W. A., the photographs having been taken by his department. As we stated in our article, the illustrations were furnished to us by the Johnson National Drillers Journal, from which we reproduced the article, and we failed to recognize them as some that had previously appeared in the A. W. W. A. Journal.

Unfortunately the information given concerning the illustrations was partially incorrect. Those shown in the A. W. W. A. Journal were, as stated, magnified 1400 times. The reproductions, however, were reduced in size to about 1060 times but the original captions retained. Moreover, the captions of the Gallionella and Cladothrix were interchanged. Also remarks attributed to W. K. Terry should have been credited to Mr. Tenny.

From our readers' point of view, the most serious of these mistakes is the interchanging of the names of the bacteria Gallionella and Cladothrix as shown on page 23; and we hope that they will make the corrections on their copies of PUBLIC WORKS, substituting "Cladothrix" for "Gallionella" under the top left-hand illustration, and "Gallionella" for "Cladothrix" under the bottom one.

We would suggest that those interested in the subject read Mr. Tenny's paper in the January Journal of the American Water Works Association.

Clarifiers after the 1938 alterations

Two Years' Experience With Chemical Treatment of Sewage: II.

Plant Improvements in 1938

By T. R. HASELTINE

Superintendent, Sewage Treatment, Butler and Grove City, Pennsylvania

The results obtained with chemical treatment of the Butler sewage during 1937 were not nearly as good as are commonly reported from chemical coagulation elsewhere. It was believed that by making certain plant changes and additions the results could be materially improved, and the following alterations and extensions were undertaken with the cooperation of the Federal Works Progress Administration:

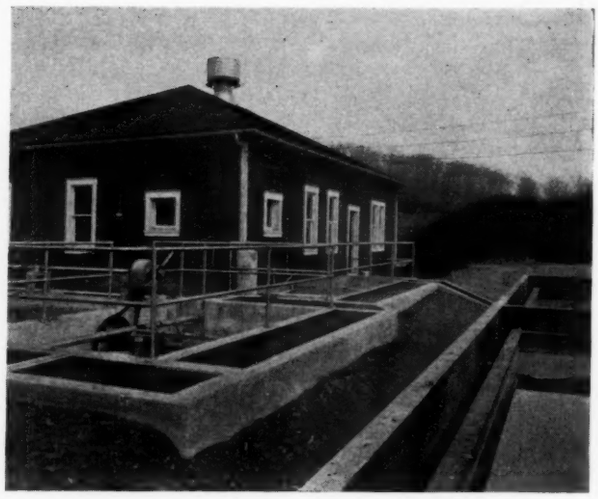
(1) *Clarifier Alterations:* In the past, sewage had been admitted to the clarifiers over a weir that extended along one side; and effluent was drawn off over another weir at the opposite sides of the tanks. Inlet distribution was very poor. During the period in which chemical coagulation was in use, it was quite common to see light flocculant material carried up and over the outlet weir. The Dorr sludge removal mechanisms had the old counterweighted corner sweeps which were intended to scrape the sludge out of the corners of the tank bottom. During chemical coagulation, it was quite apparent that the accelerated motion of these rakes, as they swung out of the corners, disturbed solids that had already settled and caused them to rise and be carried over the effluent weirs. To overcome these difficulties, we removed the corner sweeps from the mechanisms, and filled in the tank corners with masonry to form circular-bottom, square-top tanks, and arranged the tanks for center feed and peripheral overflow. At the same time, we provided for mechanical skimming of the liquor surfaces.

(2) *Additional Lime Feeding Facilities:* The combined maximum capacity of the existing lime feed machines was about 70 lbs. per hour. We found that, with that amount of lime, the pH, after coagulation, usually ranged from 6.9 to 7.3. The yellow color of the effluent, whenever much in excess of 20 p.p.m. of ferric iron was used, was believed to indicate that much of the iron remained in solution instead of flocculating out. It was hoped that by increasing the pH of the sewage, we might at least make the iron more effective, if not to actually reduce the amount used. We therefore replaced one of our old lime feed machines with a Syntron dry feeder having a maximum capacity of 250 lbs. per hour. This machine was so located that it could be used to feed alum direct to the mixing and flocculating basin if that appeared to be desirable.

(3) *Additional Flocculation:* Our laboratory work

indicated that at least a 15-minute flocculating period would be advantageous. Therefore, we extended the flocculating basin built in 1937 to give us such a period. It was expected that the higher pH and longer flocculation would give us a heavier, more rapidly settling floc than was produced in 1937, and that with the increased efficiency of the clarifiers the degree of treatment possible would be materially increased.

(4) *New Chlorinators:* No single item of equipment gave more trouble or caused more interruptions in the treatment during 1937 than did the old direct-feed chlorinators with their home-made injectors. Those three machines were replaced with two new Wallace & Tiernan vacuum feed chlorinators, each of which has a capacity of from 25 to 490 lbs. per day. These machines each discharge into a two-way distributing manifold. One manifold discharges to either, or both, the incoming sewage ahead of the bar screen and the plant effluent. The other discharges to either, or both, the copperas solution line to the flocculating basin inlet, or to the inlet of the clarifiers. The manifolds are so connected that in event one chlorinator is out for repairs, the other chlorinator can supply both manifolds.



Grit chamber, mixing and flocculating channel (altered in 1937 and extended in 1938) and chemical house

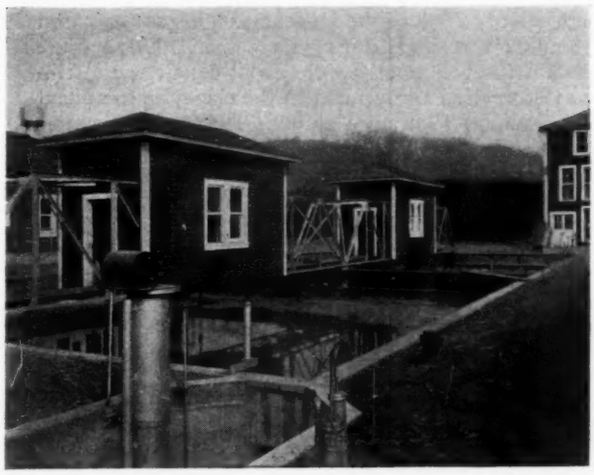
One of the clarifiers during the 1938 alterations

(5) *New Digester:* The existing digester appeared to be operating at near or beyond its maximum capacity, due in part to the large volume of chemical sludge and in part to the inadequacy of the heating coils which made it impossible to maintain digestion temperatures above 75° during the summer or 65° during the winter. Therefore, the construction of a new digester 50 feet in diameter by 22 feet deep equipped with a floating cover was underaken. It was intended to use this new tank as a primary digester and the old tanks as secondary digesters, thus making possible the

TABLE V

Year	*1938*	*1938*	*1938*	*1938*	*1938*	*1938*	*1938*
Period	*1*	*2*	*3*	*4*	*5*	*6*	*7*
From	*July 5*	*Aug. 6*	*Aug. 8*	*Aug. 22*	*Sept. 19*	*Sept. 26*	*Oct. 17*
To	*Aug. 5*	*Aug. 7*	*Aug. 21*	*Sept. 18*	*Sept. 25*	*Oct. 16*	*Nov. 6*
Total daily sewage flow, M.G.	2.41	2.36	2.42	2.23	2.24	2.14	2.17
Hrs. per day coagulation used	13.21	14.5	13.32	13.14	12.86	13.14	12.98
Sewage flow coagulated, M.G.D.	1.50	1.60	1.54	1.39	1.33	1.31	1.30
Activated alum used, lb. per day	0	0	1443	657	0	1405	1852
Chlorinated copperas used, lb. per day	817	1584	0	1111	1855	0	0
Hydrated lime used, lb. per day	1328	0	0	0	0	0	0
Post-chlorination, lb. per day	75	81	55	65	61	51	50
Pre-chlorination daytime, lb. per day	78	66	64	32	35	71	70
Pre-chlorination night, lb. per day	60	51	55	60	60	60	61
Settleable solids, cc/liter raw	6.6	7.5	7.7	9.4	9.0	9.8	9.8
Settleable solids, cc/liter effluent	0.22	0.30	0.18	0.13	0.23	0.30	2.5
Settleable solids, cc/liter % removed	96.6	96.0	97.7	98.6	97.4	96.9	74.5
Suspended solids, p.p.m. raw	327	316	290	372	341	333	393
Suspended solids, p.p.m. effluent	50	56	31	41	53	58	79
Suspended solids, p.p.m. % removed	84.7	82.3	89.3	89.0	84.5	82.6	79.9
Turbidity, p.p.m. raw	297	170	257	289	215	329	411
Turbidity, p.p.m. effluent	55	42	37	37	53	62	82
Turbidity, p.p.m. % removed	81.5	75.7	86.1	87.2	75.6	81.2	80.0
5 day B.O.D. raw	363	470	394	465	377	436	348
5 day B.O.D. effluent	125	194	110	129	133	153	117
5 day B.O.D. % removed	64.6	58.7	72.1	72.3	64.7	64.9	64.4
Volume of sludge produced, C.F.D.	2844	2828	3190	3452	2819	2824	3613
Average sludge analysis:							
pH	8.23		6.20	6.17	6.2	6.00	6.30
% solids	5.11		4.42	4.98	4.5	4.60	4.32
% organic	62.7		64.5	66.6	71.2	75.8	75.1
No. of samples	7		4	5	1	3	4
Daily cost of coagulation	$13.02	$11.72*	$14.43	$14.79	$13.73	$14.05	$18.52
Daily cost of chlorination	5.52	5.13	4.51	4.07	4.04	4.71	4.69
Total daily chemical cost	18.54	16.85	18.94	18.86	17.77	18.76	23.21
Cost of coagulation only, per 1000 lbs. B.O.D. removed	4.37	3.19	3.93	3.79	5.05	4.54	7.39

*Note: Period 2 was too short to give reliable cost data.



Clarifiers (before alteration) and weir chamber on effluent

collection of most of the gas and thereby avoiding the necessity of purchasing natural gas.

(6) *New Sludge Pump:* One of the centrifugal sludge pumps was replaced with a Barnes duplex plunger sludge pump in the hope that the volume of sludge pumped to the digester could be materially reduced. A tipping bucket sludge meter was also installed to measure the volume of all sludge pumped.

Plant Operation in 1938

All of the above improvements except the new digester were completed and ready for operation early in July. Chemical coagulation was practiced from then until early in November. Coagulant feeders were started at any time from 8:30 to 9:30 a.m. on week days, depending upon the appearance of the sewage, and stopped at 11 p.m. Sunday treatment was from 10 a.m. to 6 p.m. as in 1937. Sewage analyses were made on composites of hourly samples collected from 8 a.m. to 10 p.m. five days a week, as during 1937. The chemicals used and the plant conditions divided the 1938 run into seven periods; Table V contains chemical and analytical data for each period.

Period 1, July 5 to August 5 inclusive: Lime applied ahead of the bar screen to produce a pH at the outlet of the flocculation basin of 7.5 to 8.8; after some experimentation we decided most efficient treatment was obtained with a pH of 8.3. Chlorinated copperas was applied to inlet of flocculating basin at variable rates, as governed by the appearance of the floc at the outlet of the flocculation basin. During this period all digester overflow liquor was returned to the raw sewage. It was of good quality (probably averaging less than 0.2% total solids) and had a pH ranging from 6.9 at the start of the period to 7.4 at the close; its low pH at the start may have necessitated the use of more lime than would otherwise have been required.

Period 2, August 6 and 7: No lime used; chlorinated copperas applied as during period 1. Hydrogen ion determinations made hourly showed the pH at the outlet of the flocculation basin to range from 6.7 to 6.2.

Period 3, August 8 to August 21 inclusive: Standard activated alum applied to inlet of flocculation basin at variable rates as governed by the appearance of the floc at the outlet of the basin. Hydrogen ion determinations made hourly showed the pH at the outlet of the flocculation basin to range from 7.0 to 6.0; best results were obtained with a pH below 6.4. Since the start of chemical treatment in July there had been a gradual deterioration in the quality of the digester

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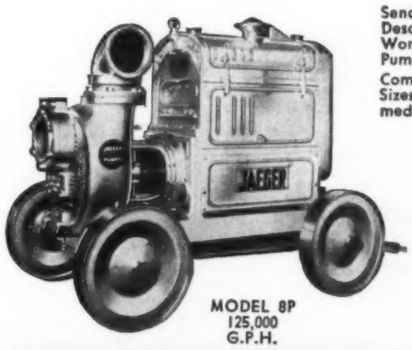

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overflow liquor, all of which had been returned to the raw sewage. From August 17 on this liquor was very black and contained from 1% to 2% total solids. On August 20 70% of it was diverted to a lagoon; piping did not permit the diversion of the balance. All digester overflow liquor returned during period 3 had a pH of about 7.4.

Period 4, August 22 to September 18 inclusive: During 1937 and periods 1 and 2 it was observed that chlorinated copperas was more effective in clarifying the morning sewage than in clarifying the afternoon sewage; during period 3 alum appeared to have the reverse effect. Furthermore, the chlorinated copperas reduced the pH of the sewage more than did an equal amount of alum although both were more effective coagulants at a reduced pH. These observations led to a trial of the two coagulants together. Chlorinated copperas was applied at the inlet of the flocculation basin and alum at a point about $\frac{1}{5}$ of the way through the basin. This order of chemical application was used partly because of Hedgpeth's experience at the Elizabeth City, N. C., water plant. (4) Samples were collected hourly at the outlet of the flocculation basin and examined for floc structure and pH. The copperas feed was adjusted to maintain a pH of 6.3 or less and the alum feed was regulated in accordance with floc appearance. Throughout this period, digester overflow liquor contained about 2% total solids; its pH ranged from 7.5 at the start to 7.3 at the close. From August 25 to 31 inclusive all liquor was returned to the raw sewage; during the balance of the period 70% of it was diverted to the lagoon.

Period 5, September 19 to 25: Chlorinated copperas, without lime, used as during period 2. Hydrogen ion determinations made hourly showed the pH at the outlet of the flocculation basin to range from 6.8 to 6.0. Digester overflow liquor continued to be of very poor quality with a pH of 7.3; only 30% of it returned to raw sewage.

Period 6, September 26 to October 16: Activated alum used as during period 3. Hydrogen ion determinations made hourly showed the pH at the outlet of the flocculation basin to range from 7.1 to 5.6, averaging about 6.3. Digester overflow liquor continued to be of very poor quality with a pH of 7.3 to 7.2; only 30% of it returned to raw sewage.

Period 7, October 17 to November 6: This period was a continuation of period 6 except that the sludge lagoon had become full, necessitating the return of all digester overflow to the raw sewage. The pH of the digester overflow ranged from 7.2 to 6.9. The pH at the outlet of the flocculation basin ranged from 7.4 to 5.6, averaging about 6.4.

Discussion

There are many factors affecting the efficiency of chemical coagulation which bear upon plant scale results but do not enter into ordinary laboratory experiments. One of the most important of these is the design of the sedimentation basins. Different chemical combinations produce floc of different specific gravities. Under the ideal (laboratory) conditions of quiescent settling this difference does not appear important, but it may have a marked influence on plant results—particularly so if the settling tanks are improperly designed or under-sized. Since all chemical floc are quite light and voluminous, the settleable solids test shows up this difference quite clearly. The alterations made to our clarifiers early last year materially increased their efficiency as determined by settleable solids tests. For example, during December, 1937, plain sedimentation removed only 75% of the settleable solids as compared with an 82% removal during December, 1938; sewage flows for the two months were about equal. We attribute most of the improvement in the chemical treatment results during 1938 over those of 1937 to the greater clarifier efficiency. Of the various chemical combinations used, the lime and ferric iron floc appeared to be the heaviest. The floc produced by ferric iron alone or alum alone appeared to be very light, but when the two coagulants were used together as in period 4 a somewhat heavier floc resulted. While all four combinations gave fairly good results during 1938, it seems probable that such would not have been the case had they been tried before the alteration of the clarifiers. At least, chlorinated copperas alone did not give good results during 1937 despite laboratory tests to the contrary.

In addition to producing floc of different specific gravities, some chemical combinations produce more fragile floc than others do. Flocculating devices, whether air or paddles, should be adjustable to avoid the breaking of fragile floc. For example, during period 1 we operated our blower at 166 cu. ft. per minute rate and obtained steady increase in floc size from inlet to outlet of the flocculating basin. When we started to use alum we found that with that aeration rate the floc built up for about a third of the way through the basin and then appeared to be broken down by further agitation. We reduced the aeration rate to 94 cu. ft. per minute and found that a quicker settling floc was obtained at the outlet of the basin than had been obtained at any point with the higher aeration rate. This lower aeration rate also gave better results when using chlorinated copperas alone or in conjunction with alum. "Tapered aeration" was used with either aeration rate.

The amount of coagulant required varied as much, if not more, with the character of the sewage as it did with the volume of the sewage. Because of this fact we paid no attention to sewage flow measurements but regulated our chemical feeds by hourly observations of pH and floc characteristics at the outlet of the flocculating basin. The flow from noon to 5 p.m. was the most highly buffered and was the most difficult to treat with ferric salts. On the other hand, alum was more effective on that sewage than it was on the morning sewage. The evening sewage was fairly amenable to treatment by either coagulant. Sewage high in laundry wastes was especially hard to treat with any coagulant, although alum seemed to give better results than did ferric iron. All sewage was quite easy to treat for several days after a heavy rain and quite difficult to treat after a prolonged dry spell. This latter phenomenon is believed to partially explain why the sewage was more difficult to treat during September and October than it was during July and August. Insufficient chemical analyses have been made to hazard any explanation of these observations.

The character and method of disposal of the digester overflow liquor has had a decided influence on the operation of the Butler plant. Since we collected our samples of raw sewage ahead of the point where that liquor entered, the analytical data in Table V do not show the true load placed upon the chemical coagulation process. So long as the digester liquor contained less than 1% solids it was quite amenable to coagulation by any of the chemicals tried. However, ferric iron, alone or with lime or alum, did appear more effective than alum alone. As the digester overflow liquor approached the consistency of thin sludge it became necessary to materially increase the chemical dosages when attempting to handle all the liquor through the

plant. The treatment of liquor containing 1% to 2% solids not only increased the amount of sludge collected in the clarifiers but increased the tendency for chunks of that sludge to rise to the surface. Therefore, it was necessary to increase both the number and length of the sludge pumping periods which increased the agitation of the digesters and aggravated their overloaded condition. The character and volume of digester overflow liquor put through the plant during the various periods of 1938 had far more influence on the volume of sludge produced than did the kind of coagulants used.

Of the various coagulants used, alum alone required the least attendance and chlorinated copperas with either lime or alum the most. The price of chemicals varies greatly from year to year, so chemical feeders must be flexible in order to take advantage of those changes. For example, when alum cost $1.27 per hundred pounds, as it did in 1937, there could be little if anything gained by its use. But in 1938 when it cost only $1.00 per hundred pounds it was cheaper than chlorinated copperas, either with or without lime, and gave at least as good if not better results. Judging from periods 3 and 4, Table V, the use of alum and chlorinated copperas together gave slightly better results than did alum alone and cost slightly less. The best chemical quotations recevied for 1939 indicate that alum will cost $1.15 instead of $1.00 and chlorine will cost $2.11 instead of $2.59 per hundred pounds. While the saving in chemical costs due to the use of chlorinated copperas and alum together during 1938 were not sufficient to justify the extra attendance required over that needed for alum alone, it seems quite probable that, under 1939 prices, that combination will be quite attractive from a cost viewpoint as well as from the viewpoint of producing the best possible effluent.

Even the best of chemical treatment is not adequate for Butler's sewage during periods of minimum stream flow. Therefore, the City took advantage of PWA funds to make major additions to the plant involving trickling filters, gas collection and power production from the gas so collected. The Chester Engineers, Consulting Engineers, designed these major extensions which are now under construction. Their design is predicated upon the continued use of chemicals to reduce the loading on the filters.

Acknowledgment.—The writer wishes to express his appreciation of the assistance and advice of C. H. Young, District Engineer, State Department of Health, in both the operation of the plant and the design of the 1937-38 improvements to it. Credit is also due George M. Thompson, Mayor, Fred M. Harper, City Engineer, and the members of the Butler City Council for their ready cooperation in the experimental work and improvements reported herein.

A Laboratory Concrete Mixer

For use in the concrete laboratory, H. R. Webb and W. W. Preston, of the Department of Civil Engineering, University of Alberta, designed and built a small concrete mixer. As described in a recent ASTM Bulletin, this mixer was designed on the basis of the 4-yd. or 108-ft. mixers used on the Grand Coulee Dam. A capacity of 0.67 cu. ft. was chosen, which is large enough for three 6 by 12-inch test cylinders, or about 100 pounds. Dimensions of the Grand Coulee mixers were copied on the linear scale ratio of the cube root of 108/0.67, or 5.451. An old gear reduction box from a washing machine was used. The mixer is placed on a frame mounted on casters for easy moving, and is dumped by lifting the base at the back end.

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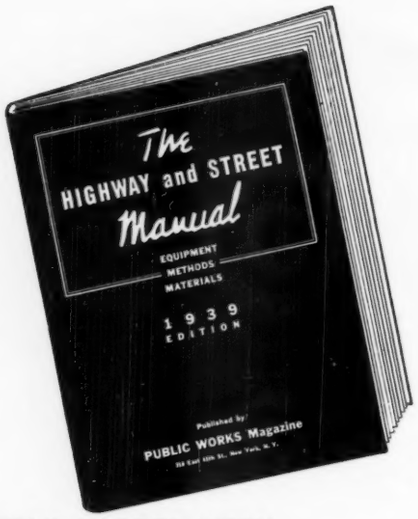

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Soil Classification by Weight

SOIL may be considered as layers or deposits of disintegrated rock lying on or near the surface of the earth which have resulted from natural processes such as weathering, decay, and chemical action, in which at least 40 per cent by weight of the grains or particles are smaller than a No. 200 mesh sieve. *Shale* may be defined as finely laminated rock formed by the consolidation of soil including clay, silt, and fine sand. *Granular material* includes natural or synthetic mineral aggregate — such as broken or crushed rock, gravel, sand, cinders, or slag—which can readily be incorporated in an 8-inch layer, and which, after being placed in embankment, contain insufficient material to fill the interstices between the stone particles.

Various soil classifications are in use, with those of the Bureau of Public Roads probably being most common. However, with the adoption of the density specification for compaction and moisture control, a new method of classification has been developed. This classification is based essentially on maximum obtainable laboratory densities, as performed in accordance with the requirements for the Proctor test.

It has been observed that materials weighing about 120 pounds per cubic foot dry, normally are sands and gravels containing rather small quantities of silt and clay. These materials are known to serve entirely satisfactorily in embankments as well as in subgrades and are usually considered good to excellent for use in embankment.

Likewise, materials with maximum dry weights of 110 to 120 pounds are normally silts of the Bureau of Public Roads A-4 and A-5 classification. These types make good embankments and subgrades when used at a moisture content below the optimum, but they are subject to frost heaving and are particularly unstable when placed in embankments at a moisture content above the optimum. It can be seen then that such materials can be considered only fair for use in embankment and may even be unsatisfactory if used at an excessive moisture content.

Materials weighing from 100 to 110 pounds per cubic foot are usually clays of the Bureau of Public Roads A-6 and A-7 classification and make satisfactory embankments when placed under reasonable control. Such materials require more rigid control during construction than do the better types.

Materials weighing less than 100 pounds per cubic foot are likely to be organic silts or very poor types of

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Maximum Laboratory Dry Weight (Pounds per cubic foot)*	*Minimum Field Compaction Requirements (Per cent of dry weight)*	*Maximum Laboratory Dry Weight* (Pounds per cubic foot)*	*Minimum Field Compaction Requirements (Per cent of dry weight)*
89.9 and less	**	94.9 and less	***
90.0— 99.9	95	95.0— 99.9	100.0
100.0—109.9	95	100.0—109.9	100.0
110.0—119.9	90	110.0—119.9	95.0
120.0—129.9	90	120.0—129.9	90.0
130.0 and more	90	130.0 and more	90.0

*Maximum laboratory dry weight is obtained as described in "Information from the Laboratory, No. 3 Sampling and Testing Soil for Use in Embankment, Ohio Department of Highways."

** Soils having maximum dry weights of less than 89.9 pounds per cubic foot will be considered unsatisfactory and shall not be used in embankment.

*** Soils having maximum dry weights of less than 94.9 pounds per cubic foot will be considered unsatisfactory and shall not be used in embankment under Condition II requirements.

clays. Such types are many times wasted or if used they must be placed under very rigid field control.

The table herewith shows the range of soil types by maximum laboratory dry weights and the compaction requirement for each type for two conditions of use which was recently adopted by the Ohio Department of Highways as one part of their new embankment specification.

These data are abstracted from a paper at the 1939 Purdue Road School by K. B. Woods, assistant director of the Joint Highway Research Project, Purdue University.

A Small Up-to-Date Treatment Plant

Dickinson, N. D., is completing a treatment plant that in its up-to-dateness is ambitious for a town of 6,000 population (Estimated to be 8,000 by 1960). Its essential features are a high-capacity filter (the first in the State), primary and secondary clarifiers, sludge digester and sludge drying beds.

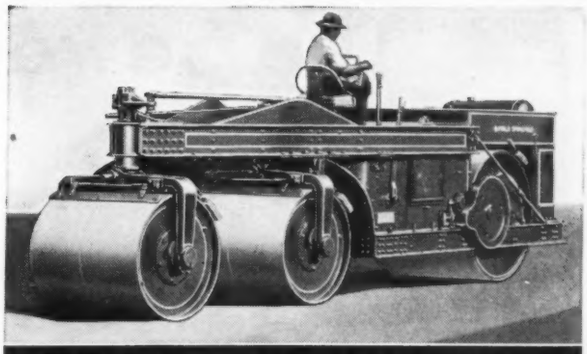
Minor features are a comminutor; measuring chambers with proportional weirs for raw sewage and for return sewage to raw, respectively, the flows being recorded on electric recording meters; and recirculating pumps for returning part of final effluent to primary clarifier. Both clarifier basins are provided with sludge removers.

Besides the high-capacity filter, there are two other features unusual for a small plant—automatic control, and enclosure of all units in buildings that are ventilated and heated. The motors operating the mechanical equipment may be started and stopped either manually or automatically. The controls for the entire plant are centered on two panel boards in the control building, one of which contains the electric meters, main switch and fuse boxes, the other contains 3 synchronous motor timers to operate the clarifier and digestion tank mechanisms, and the sludge pumps. The recirculating pumps are controlled by float switches set to operate one or both according to rate of flow of raw sewage to the plant. The comminutor also is controlled by a float switch. Or any of the equipment can be operated manually from the panel board by means of "Auto-Manual-Off" type switches.

The control building is connected by enclosed passageways with buildings which house the primary clarifier, filter and secondary clarifier; and all these are heated by means of a forced draft warm air furnace; the digester gas serving as fuel for this as well as for heating the digestion tank. Air also will be circulated through all these, which is expected to control condensation during extremely cold weather. The buildings are circular and covered with concrete dome roofs of the Hewett type. The walls are of tee-shaped structural tile and glass blocks are used for lighting, and ventilating louvres are installed.

One reason for adoption of the high-capacity filter was the high cost of suitable rock for filter medium, which would have to be brought from central Minnesota at a cost for transportation of upward of $5 per cubic yard; it being found that a standard filter would require 2,500 cu. yds. of rock but a high-capacity filter only 360 cu. yds., while the latter is expected to give as high B.O.D. reduction as the former and more flexibility of operation.

The above is condensed from a paper by L. W. Viegel, engineer of Dickinson, in "Official Bulletin of the North Dakota Water and Sewage Works Conference."



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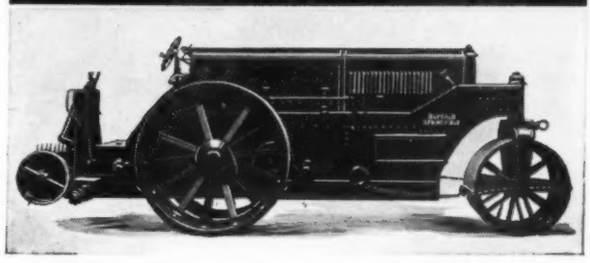

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The Sewerage Digest

A Digest of the Sewerage Literature of the Month giving the main features of all the important articles published

Gas Engine Maintenance

Advice by an operator of 535 hp. and 300 hp. sewage gas engines at Peoria. Exhaust valves must be reseated every 2 or 3 months and intake valves every 4 to 6 months. Every 6 to 8 months, pistons should be removed for removing carbon deposits around piston rings and replacing greatly worn rings. About once a year, main crank shaft and connecting rod bearings should be examined for clearance and the former for alignment. Every two or three years, clearance between wrist pins and their bushings should be measured. Air starting valves should be inspected each time the engine is dismantled. Spark plug gap adjustment should be made monthly, and magnetos and distributors once a year. The oil in the circulating system should be inspected monthly (weekly at first) and oil screens cleaned every 3 or 4 months and oil coolers cleaned periodically. Water jackets should be inspected for scale deposits. The gas governor should be inspected each time the engine pistons are removed. Air filters should be cleaned or changed and mixing valves adjusted and lubricated occasionally. The air compressor requires occasional inspection and repair. Safety devices and gauges should be checked frequently.[H50]

Handling Sludge at Elizabeth, N. J.

The sewage treated at the Joint Meeting plant averages 26.28 mgd. Treatment consists of coarse and fine screening, screenings grinding and sedimentation. Suspended solids are reduced from 184 to 61 ppm. Sludge averages 72,608 gpd. of 94.5% moisture content. This is pumped daily to two 626,000 gal. storage tanks, where it settles and 30,150 gal. of liquor is decanted daily and returned to raw sewage without ill effect. Twice a month the sludge is barged to sea, at a cost of $20,604 a year. The tanks are unheated and little digestion takes place, but the sludge stratifies and acquires a jelly-like character and resists efforts to make it flow by gravity from the tanks to the barge. When centrifugal pumping was tried, difficulty from cavitation occurred. Even if no water is decanted, the concentrated sludge and supernatant refuse to remix. The only solution found is to break up the gelatinous mass by use of a water jet under 50 lb. pressure. With temperature of 70° the pumps operate against a head of about 12 ft., but when the temperature falls to 50° the head rises to over 40 ft., and the pipe line to the barge has to be blown out frequently with compressed air at 30 lb. pressure. Even so, the total cost of sludge disposal is only 30.5 cts. a ton—less than by any other known method.[E26]

Cost of Buffalo Sewage Treatment

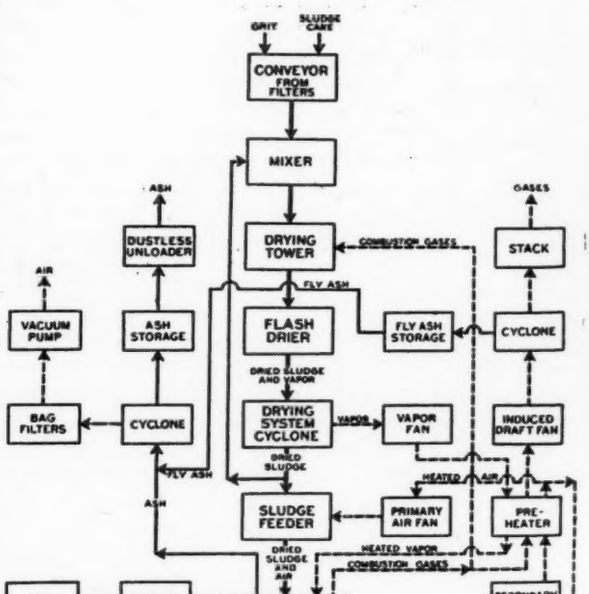
Buffalo, N. Y. put into operation in June 1939 a sewage disposal works and pumping station costing $4,378,891, of which about $3,500,000 was for the treatment plant, equivalent to $4.67 per capita. The sludge dewatering equipment cost $74,965 and the incineration equipment $257,500, for handling 108,000 lbs. of dry solids per day. The estimated annual operating cost of treatment (not including debt service) is $397,000; including sewer maintenance, pumping, debt service, overhead and miscellaneous, the total annual cost is estimated at $1,500,000. To raise this revenue, 55% is obtained by a charge based on water consumption, and 45% is paid by all taxable property in proportion to assessed valuation—about 73 cts. per $1,000.[K4]

Treatment Results at Perth Amboy Plant

In treating 3½ mgd. of sewage of high industrial origin and extremely variable in character, Perth Amboy, N. J., reduces suspended solids 80%, B.O.D. 34%, magnetite filters aiding greatly in solids reduction. Ferric chloride and lime are used for coagulation 4 months of the year, lime occasionally during the other 8 months to raise the pH. Chlorine is used continuously, 24 lbs. per mg. Sludge is dewatered from 12.1% solids to 33.2%, vacuum filters treating 5.03 lbs. of dry solids per hour per sq. ft. Grease was troublesome, plugging pores of filter cloth. Average life of cloth, 310 hours.[H51]

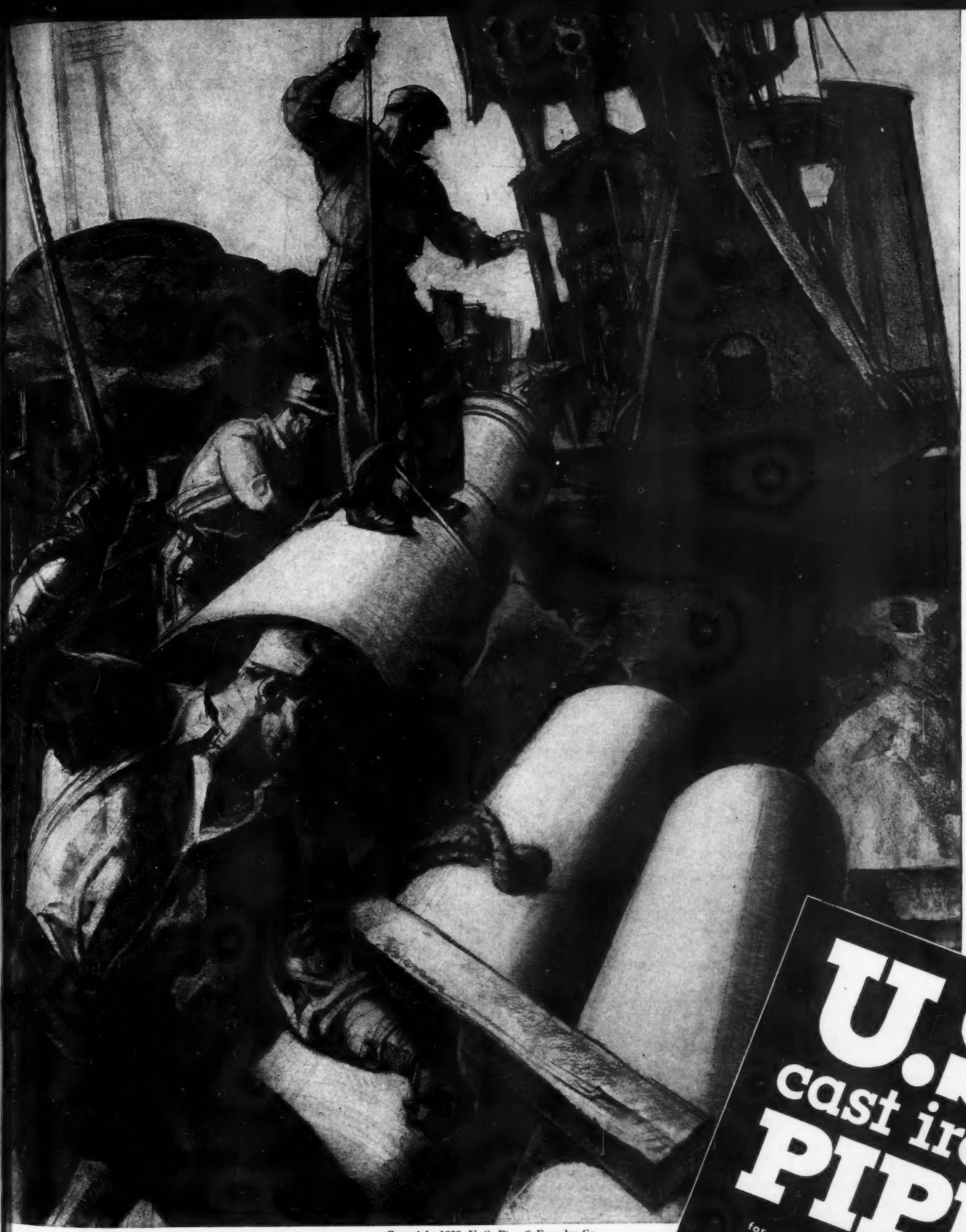
Detroit's Sewage Disposal Plant

A plant is nearing completion for treating the sewage of Detroit, Mich., which, although unusually large, is simple in principle. It will serve a present population of 1,600,000, eventually one of 2,400,000. It consists of sedimentation, with incineration of sludge and chlorination of effluent. It occupies an area of 72 acres. After passing through screenings, racks and grit chambers, the sewage passes to sedimentation tanks. It may be chlorinated either before or after sedimentation. Sludge will be pumped continuously from the sedimentation tanks, ⅞ of it going directly, after chemical conditioning, to sludge filters and then to in-



Proceedings, Am. Soc. of Civil Engineers

Flow diagram, Buffalo sludge inceration unit



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cinerators; the remainder being partially digested, followed by elutriation, dewatering on vacuum filters and incineration. Filtration and incineration calculations were based on an assumed removal of 55% of the suspended matter in the raw sewage. Only primary treatment seems necessary, since the Detroit river, at its low flow, will in 1970 give a dilution of 150 to 1 and is saturated with oxygen; but bacteriological requirements are especially great since 50,000 people obtain their water supplies from the river below the city and bathing in it is popular.

The grit chambers have several unusual features. They are 150 ft. long and 15 ft. deep (extra deep to reduce area occupied), detention time 2½ minutes; they are covered, and the space above the sewage is ventilated to a stack.

The 8 sedimentation tanks also are covered with a concrete slab roof close to the water surface, covered with 18" of earth to avoid nuisance. They are 272 ft. long, designed for flow velocities of 3.0 ft. per min. average and 5.5 ft. maximum. Each tank, 117 ft. wide is divided by continuous longitudinal walls into 7 channels 16 ft. wide. Because of the length, the sludge collectors will travel at 2 ft. per min. instead of the customary 1 ft.

There are four 12-hearth incinerators (two more provided for), each having a rated capacity of 300 tons per day of wet sewage solids with 70% moisture content. These solids are composed of sludge cake with 70% moisture, screenings with 85% moisture and grit with 35%. It will require 1500 gal. of fuel oil to start each cold dry incinerator, after which no auxiliary fuel will be required. Ash is removed, by the hydraulic sluicing system, 1200 ft. to two ash lagoons, each 250 x 500 ft. by 6 ft. deep, each giving six months storage. A 90 hp high-pressure sluicing pump delivers 900 gpm at 185 ft. head.

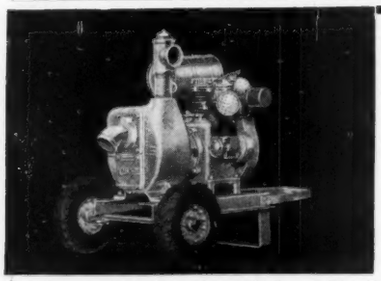
Surplus sludge gas is stored in a spherical gas holder at pressure up to 30 lb., the cost of this being only 60% as great as that of gravity type. It is estimated that power can be generated by this gas at a cost of 0.3 ct. per kwh.[C61]

Arch Top vs. Box Type Culverts

Whittier, Calif., has built both box-type and arch-top culverts with WPA labor and finds the latter more satisfactory in every way for 18" to 66". The forms for the top slab of the box type must be left in place until the concrete has thoroughly hardened, but in the semi-elliptical arch top the forms can be removed much sooner and much less reinforcement is needed. Up to 30" no forms are used, but in their place pre-cast concrete liners 1" thick in 6 ft. lengths, using metal-lined forms to give a smooth inside finish. For larger sizes, the inside forms are of wood, in two 10 ft. units hinged at the top and blocked up at the bottom; there are no inside braces to interfere with water flowing through the newly-poured culvert in case of a rain.[J19]

Sanitary Fill At Portland, Ore.

Portland, Ore., built an incinerator in 1897, replaced it in 1910, reconstructed this in 1927 (soon to be abandoned) and in 1932 built a 150-ton incinerator, with land adjacent for sanitary fill, at a new site about 10 mi. from the downtown area. In 1938 disposal of 75 tons per day of refuse cost 81½ cts per ton by incineration and 39¼ cts by fill; the former requiring more labor at higher wages. Sanitary fills up to 85 ft. deep have been made, about one-third being dirt cover; settled 25% in ten years. Present practice is to excavate soft ground ahead of the fill (used, with ashes, etc. from incinerator, for cover material), dump refuse 7 to 8 ft. deep, compact it with tractors that level it off (incidentally killing or frightening away all ro-



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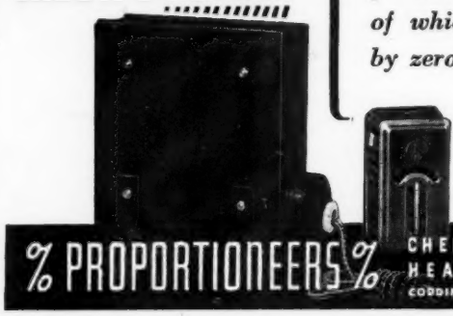

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dents), each day's filling being compacted that day, and cover it with a foot of earth by means of a bulldozer. Three such layers, or a total depth of about 20 ft., is contemplated, with a final cover of 3 ft. of top soil adequate for plant growth. Only two men are employed, one driving the tractor, the other bringing dirt with a fresno.[E24]

Sewer Construction Details At Cranston, R. I.

Cranston, R. I., population 50,000, has no sewerage whatever. A system is now under construction including 87 miles of 8″ to 36″ laterals and trunk lines and 9 pumping stations (all the sewage is pumped, some of it three times); and a treatment plant is being designed. Manholes, 4 ft. in diameter, are of brick up to a point two courses above the highest entering pipe, the rest is of concrete poured into metal forms; walls 12″ thick where there is much groundwater, elsewhere 8″. All sewer joints are made with bituminous compound. Sewer lines are placed 2 ft. off center line in 40 ft. streets, to 4 ft. in 60 ft. streets. Trenches are excavated 4 ft. wide by trench hoe for a depth of 5 to 9 ft.; then sheeting is driven to the grade of the sewer and excavation completed with crane and ½-yard clamshell bucket.[E26]

Bibliography of Sewerage Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

C *Sewage Works Journal*
September

74. *t.* Occurrence and Role of Colloids in Sewage and Sewage Treatment. By W. Rudolfs and H. W. Gehm. Pp. 727-737.
75. *t.* Chemical Coagulation of Sewage: Effect of Soluble Matter on Coagulation. By H. W. Gehm. Pp. 738-751.
76. *t.* Activated Sludge Process: Morphological and Biochemical Studies of Zoogleal Organisms. By H. Heukelekian and M. L. Littman. Pp. 752-763.
77. *t.* Filtration Tests with Elutriated and Unelutriated Digested Solids. By P. D. McNamee. Pp. 764-773.
78. *t.* Discussion of C 77. By A. L. Genter. Pp. 774-780.
79. *t.* The Use of Sodium Azide in the Winkler Method for the Determination of Dissolved Oxygen. By G. R. Barnett. Pp. 781-787.
80. Application of Sewerage Finance Methods. By F. S. Friel. Pp. 788-802.
81. Trends in Sewage Treatment. By W. A. Hardenbergh. Pp. 803-810.
82. Determination of Extent and Degree of Pollution by Sewage of Shores of City and County of San Francisco. By J. C. Geiger, C. G. Hyde and A. B. Crowley. Pp. 811-818.
83. Continuous Digestion of Mixtures of Sludges from Domestic Sewage and Packing House Wastes. By O. J. Knechtges, F. M. Dawson and M. S. Nichols. Pp. 819-827.
84. Chemical Precipitation of Textile Wastes and Studies of pH Control. By R. Porges, R. K. Horton and H. G. Baity. Pp. 828-863.
85. Digestion Studies on Paper Pulp. By M. T. Hill. Pp. 864-876.
86. Good Housekeeping. By L. S. Morgan. Pp. 877-887.
87. Laboratory Control of Sewage Treatment. By M. W. Tatlock. Pp. 887-892.
88. Report of Belvidere, Ill., Sewage Treatment Dept. By M. Lamb. Pp. 897-903.

E *Engineering News-Record*
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24. Sanitary Fill Disposal Method Preferred in Portland. Pp. 58-59.
25. Waste Disposal Profitable at Fresno, Calif. P. 59.
26. Sewer Design and Construction—1939 Model By E. J. Cleary. Pp. 65-70.
27. Mississippi River Pollution Reduced by Twin Cities Plant. P. 70.

October 12

28. Unusual Sewage Plant Operation. (Joint Meeting, N. J.) Pp. 57-60.

G *Water Works & Sewerage*
October

39. A Centrifugal Extractor at Elizabeth, N. J. By L. J. Murphy. Pp. 413-414.
40. Sludge Filtration. By L. W. Van Kleeck. Pp. 415-419.

H *Municipal Sanitation*
October

50. A Guide to Gas Engine Maintenance. By L. S. Kraus. Pp. 480-484, 505.
51. Treating a Heavy Industrial Wastes Load. By A. J. Gadowski. Pp. 485-487.
52. Sewer Rental Enforcement Proves That Courtesy Pays. By L. B. Barnes. P. 487.
53. Gas Hazards and Their Elimination. By A. L. Shaw, G. E. Flower, W. M. Piatt, E. A. Reinke, G. Martin, R. M. Dixon. Pp. 489-490.
54. Effect of Industrial Wastes on Municipal Sewage Treatment. By E. F. Eldridge. Pp. 491-494.

J *American City*
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18. Trailer-Mounted Sewer Cleaner Removes Roots and Deposits. Pp. 50-51.
19. Monolithic Concrete Culvert Construction in Whittier, Calif. By L. R. Abbott. Pp. 56-57.

K *Proceedings, Am. Soc. of Civil Engineers*
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4. Sewage Disposal Project of Buffalo, N. Y. By S. A. Greeley. Pp. 1341-1365.

P *Public Works*
October

42. *c.* Building a Small Sewage Treatment Plant Under Unusual Conditions. By R. M. Lingo. Pp. 18-19.
43. Outside Sludge Heater for the Iowa Great Lakes Sewage Works. P. 24.
44. Two Years' Experience with Chemical Treatment of Sewage. By T. R. Haseltine. Pp. 30-34.

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The Waterworks Digest

Abstracts of the main features of all important articles dealing with waterworks and water purification that appeared in the previous month's periodicals.

Valuation of Water Works Systems in Canada

In valuation of water works properties for transfer of ownership, Canadian legislation and court decisions seem to determine:

(1) That reproduction cost new less depreciation is the broad basis on which valuations are to be determined.

(2) That material values only and not intangibles are to be given consideration unless otherwise specifically provided for under some contract or agreement.

(3) That the legislatures in some provinces recognize the difficulty of distinguishing between material and intangible values and for this reason definitely cite those elements which are not to be included in the valuation.

(4) That the experience under the Ontario Statute has been sufficiently satisfactory for it to remain unchanged for more than 50 years.

(5) That the vendor is entitled to additional compensation where expropriation and arbitration are resorted to as evidenced by the 10 per cent and 15 per cent increase provided in the Ontario and Quebec statutes respectively.

(6) That the majority award is not always right as shown by court decisions.

(7) That the value to the vendor has priority to that of the purchaser.

(8) That Courts of Appeal and Privy Council judgments are in accord on the principle of utilizing reproduction costs less depreciation.[A114]

Valuation of Water Works in the United States

There is a decided difference of opinion as to whether "fair present value" or "prudent investment" should be the basis of public-utility valuation. Several state commissions use "prudent investment," while others prefer it but do not use it, because they feel that it is contrary to the decisions of the United States Supreme Court. Ever since 1923, it has been apparent that a minority of the Supreme Court believes that "prudent investment" should be the basis of valuation. There is, at the present time, a valuation case pending before the Supreme Court, in which the Attorney General of the United States has argued that a re-examination of the fair-value rule should be made and that "prudent investment" should be adopted as the rate base.

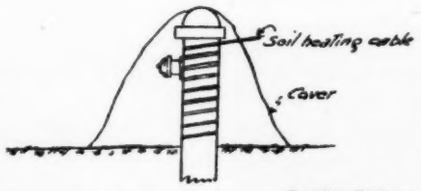
It is quite evident that the question of valuation is still a perplexing problem. It is most difficult for an engineer to advise a client as to the value of a utility, because, regardless of the engineer's opinion as to the correct method of valuation, there is such a difference of opinion among courts and commissions. The determination of the value of a property is an embarrassing question, as a member of the highest court has said.[A115]

Slow Sand Filter for Hampden, Me.

The Hampden Water District adopted slow rather than rapid sand filters because it thought the small consumption (500 buildings in the District) did not justify cost of chemical and operation. The slow sand filter is electrically operated, 40 ft. square with 3 ft. of sand of 0.30 mm effective size, 2.84 uniformity coefficient. The low lift electric centrifugal pump that raises water from river to filter is operated by a switch connected to a float in the clear well. Water is pumped from the clear well by a 100 gpm electric pump started by a pressure switch when the water in the standpipe falls to 12 ft. from the top, and is stopped when standpipe is full, also if clear well becomes empty. Flow from the filter is controlled automatically by hydraulic valve controlled through solenoid valve by a float in the clear well. When water is being pumped the filter operates at about 5 mgad.[F73]

Maintenance for Extremely Low Temperatures

In Temiskaming, Que., temperatures reach 60° below zero. Mains and services are laid with a minimum cover of 5 ft. Soil is glacial drift containing 40 to 60% boulders. Frost penetrates 4½ ft. in traveled streets, seldom exceeds 3½ ft. in sodded lawns. Services are sometimes laid near the surface on top of rock, and soil-heating cable (18 gauge Nicrome resistance wire insulated in lead sheath) in a conduit is laid close to it. Such services, even with only 10″ or 12″ cover never freeze. Current for a 60 ft. length of cable costs $1.10 a month at ½ ct. per kwh, using 110 volts, which heats the cable to 175°. Portable transformer outfits are used for thawing. Although ice may form quite deep on the street, a cable in the gutter keeps an 18″ channel open all winter.



Canadian Engineer

Thawing hydrant with soil-heating cable

To pervent hydrants freezing, drips are connected to the sewer. They are inspected daily during the winter. If frozen, they are thawed by wrapping a 60 ft. length of soil-heating cable around the exposed part of the barrel and covering the hydrant with canvas or other protective means. The heat travels down the barrel and thaws the ice free and it is then flushed out of the nozzle.[M8]

Rainfall And Run-Off

"For 10% frequency of all the storms (from 1550 observations) over ½ in., abandoned farm land, overgrazed pasture, and denuded lands produce peak discharges respectively 12, 24 and 47 times as great as forest land." "The undisturbed, deep soils of forested areas have a very high infiltration capacity; in fact, it is questionable whether this capacity is ever exceeded by rainfall intensity." "For comparable forested areas, peak percentages of runoff consistently decrease as the drainage area increases."[L11]

Unit Hydrograph For Small Streams

For any water-shed, the surface run-off resulting from a unit storm is distributed, according to time, in a characteristic manner, and this distribution is independent of the intensity of the rainfall. A unit storm is a rain of an intensity sufficient to produce surface run-off which occurs within the rise of the hydrograph, which is the time

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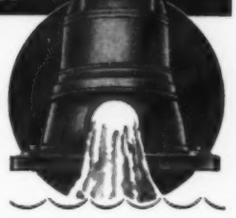

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from the beginning of surface run-off to the occurrence of peak discharge. A unit hydrograph is a hydrograph of surface run-off resulting from a unit storm.

The unit hydrograph method permits the engineer to estimate the maximum rate of run-off to be expected from a water-shed, or the peak for any desired time interval. No empirical formulas are involved but the physical characteristics of the water-shed have a direct bearing on the computations. Unit hydrographs for small streams may readily be selected from continuous run-off records. They offer an important aid in separating ground water from surface run-off. There is a definite correlation between the shape of the distribution graphs and the water-shed characteristics.[K6]

Odor Control At Charleston, W. Va.

Oily and gasoline wastes entering the river a few miles above the intake, in addition to microscopic organisms in summer, cause troublesome tastes and odors in the filter plant at Charleston, W. Va. Aeration, accompanied by large doses of activated carbon, are found most effective in elimination. Types and intensities of taste and odor fluctuate, and samples are taken at key locations throughout the plant at half-hour intervals, and it is very rare that water containing taste and odor enters the distribution system.[F79]

Air Mixing At Charleston

Mixing chemicals at the Charleston, W. Va., filter plant is effected by air. Six horizonal lines of 2" pipe with 3/32 in. holes on top, are laid across the sedimentation basin 8 ft. above the bottom (14 ft. below the surface), into which air is pumped; they are located 4 ft. in front of the baffle, between baffle and inlet trough, and 20 ft. from the latter. The entering water is directed downward and through a vertical-slat baffle, and the rising air curtains give the water a rolling motion. This produces an excellent floc, aided no doubt by sludge swept from the bottom. It also saves as much as 22% of the coagulating costs during periods of high turbidity, or about 10% per year. The maximum air requirements are 25 cu. ft. per min. (at 10 lb. pressure); minimum, 15 cu. ft. at 7 lb.[F79]

Recarbonation by Submerged Combustion

Standard equipment for recarbonation of lime-softened water is massive, costly to install and maintain, subject to severe corrosion and difficult to control. At the Oklahoma City plant equipment has been developed for burning gas in a submerged burner, with advantages of controllability, simplicity of equipment, greater chemical efficiency, trouble-free operation, reduced maintenance, elimination of water and filter materials for scrubbing towers, and elimination of corrosion troubles, at unit costs equal to or less than by present methods—estimated at 60 to 90 cts. per m.g. of water treated.

Air and gas are supplied, each at 7 to 10 lb. pressure, and mixed and delivered to a burner 7 to 9 ft. below the water surface. The burner is a cylinder entirely open at the bottom, equipped with a frustro-conical expansion chamber at the upper end. The burned gases leave the bottom of the cylinder as countless bubbles. Two methods of diffusion in the water were tried. The chemical efficiency of recarbonation in use of the fuel exceeded standard methods by 10% to 20%. Either hand control, or automatic using a pH recorder controller, can be used.[G39]

Adequacy of the Treasury Dept. Standard

The so-called Treasury Dept. standard for drinking water was not intended for general application and is considered by some as not adequate therefor, but only three cases of any prominence are known where water that met this standard has been implicated as transmitting disease. In one, a chemical irritant was probably responsible; in the other two, there had been a marked increase in the numbers of presumptive coliforms in the tap water immediately preceding the outbreak, and corresponding increase in the 37° counts. Because of these, a tentative standard for chlorinated surface water was suggested, providing that chlorine demand do not exceed 0.2 ppm, residual chlorine at no time be less than 0.2 ppm after 10 min. of contact, that the 37° count do not exceed 50 per cc, and that the coliform index do not exceed 0.2 per 100 cc.; while Baylis suggests coliform index limit of 0.1 and 37° count limited to 2 per cc. Streeter concludes more effort should be made to improve the technique of coliform tests, particularly in chlorinated waters, to detect significant changes in the bacterial flora which may be associated with the endemic or epidemic prevalence of disease of bacterial origin, including some forms of gastro-enteritis. It is possible that the presumptive coliform index is more important than is now generally believed.[A121]

Water-Borne Gastro-Enteritis

Judging from New York State data, outbreaks of gastro-enteritis are due to specific bacterial infections and not to pre-formed toxins or irritating substances. Under abnormal conditions, irritating substances may be produced by the atypical decomposition of organic matter in water, or by the presence of specific chemical irritants; but the latter are not likely to occur except when the raw water is very seriously polluted. The present bacterial standards of water quality are adequate for the control of diarrheal diseases if they be considered in connection with pertinent physical and chemical data; and present water treatment processes likewise are adequate when properly controlled and when they are not overloaded.[A122]

Bacteria From Chlorinated Waters

The evidence, on the whole, indicates that survival of coli-aerogenes strains in chlorinated water is probably due to presence of clumps of bacteria or protection of the organisms by some constituent of the water, rather than to resistance of the individual bacteria themselves to the action of chlorine. In view of the fact that non-spore forming members of coli-aerogenes—Eberthella, Shigella, Salmonella and other closely related genera—have been isoated from waters which showed high chlorine residuals, even after contact periods of two to six hours, it appears that a chlorine residual of 0.2 to 0.4 ppm, as at present determined by ortho-tolidine, is in itself not a dependable criterion of adequate water sterilization.[A123]

Copper Sulphate Rates for Western Waters

Rates of application of copper sulphate for killing various algae as given by Whipple based on the standards of Hale apparently do not apply to all waters. In Pasadena, Calif., Morris reservoir, eudorina and pandorina are killed by less than one fifth the 83 lb. per mg specified. On the other hand, the amount specified for anabaena, corrected for various factors, is 1.67 lb., but 2 lb. applied in Morris reservoir had no effect on them, but 4 lb. wiped them out immediately. Whipple states that more than 1.2 lb. per mg will kill trout; but 2 lb. does not do so in Morris reservoir, and after a 4 lb. rate only 5 dead trout were found.[F74]

Advantages of Super-Chlorination

Super-chlorination consists in the application of high doses of chlorine to secure correspondingly high concentrations of residual chlorine, which in turn result in chemical actions differing in character from those secured by conventional chlorination. It permits

obtaining, without frequent changing of the chlorine doses, (1) more certain disinfection, especially where the amount of residual necessary is in doubt or produces chlorinous tastes; (2) more rapid disinfection in a limited period; (3) more adequate use in destroying protective organic colloids and in oxidizing iron and manganese, whereby improved coagulation is secured; (4) control of algae and other micro-organisms in coagulation basins and filters; (5) preventing chlorinous tastes where alkaline waters are treated and when stable hypochlorite compounds otherwise are produced; and (6) destruction of taste-producing compounds.[A125]

Water Tank Inspection

Every water tank should be inspected at least once a year. Rust streaks at seams or rivets indicate inside corrosion. The roof should be within ¼" of the top edge of the tank all around. Overflow should be screened to keep out birds and bugs. Calibrate altitude gauges by filling tank to overflowing. Inspect ladders up the tower and inside and outside the tank. Inspect riser pipe for leaks (possibly due to defective expansion joint). See that the brace rods on the tower are tight but not too tight. Remove any birds' nests on the tower. Inspect paint for rust, blisters or scale. Drain tank, remove sludge from bottom, wash down, and scrape off all loose paint, rust and scale. Inspect for pitting; a pit extending half way through the steel is dangerous. Inspect each rivet head, and the seam edges for pitting or destruction of the calking edge. Inspect spider for sag, broken or loose rods.[X2]

Meter Accuracy in Roanoke, Va.

Roanoke for several years followed the plan of testing all meters after 5 years' service (also any showing apparent under-registration); then tried 6-year interval, then 7-year, and, by comparing costs and savings obtained, calculated that the last was the most economical in that city. The testing is distributed uniformly throughout the year. By use of a recording register on meters of all kinds of consumers they found that 31% of residence consumption was at a 2 gpm rate, 40% at a 5 gpm rate, 10% at 10 gpm, 8% at 1 gpm and only 11% under 1 gpm. After 7 years' service, registration at 2 gpm or over averaged over 99% and totals at all rates averaged 96.86%. Meters of all ages after 7-year testing and repair, averaged slightly under this for 2 gpm and over, but fell off for 1.0, 0.5 and 0.25 gpm, down to 45.6% for the last; but average of all registration was 94.78% of actual consumption.[G33]

Checking Water Waste by Sewage Flow

Denver, Colo., measures continuously the water entering the distribution system and the sewage entering the treatment plant, and finds the latter is 95% of the former except when used for lawn sprinkling. To aid in detecting waste of water, inspections are made at manholes where small sewers enter large ones, usually between 2 and 4 A.M. If the flow is greater than seems reasonable for actual use, house-to-house inspections are made the next morning.[G35]

Bibliography of Waterworks Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

A *Journal, American Water Works Association*
September

118. Methods for Inspecting Pipe Lines. By K. H. Logan and E. A. Koenig. Pp. 1451-1470.
119. Grounding Connections to Water Pipes. Committee Report. Pp. 1471-1474.

METER BOX COVERS

Ford meter box covers for water meter settings are made in single and double lid types and in many sizes. Write for complete catalog describing covers and other equipment for water meters.

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120. Symposium on Water Quality. By G. D. Norcom. Pp. 1475-1478.
121. Standards of Raw and Treated Water Quality. By H. W. Streeter. Pp. 1479-1488.
122. Water-Borne Gastro-Enteritis. By C. R. Cox. Pp. 1489-1510.
123. *t.* Bacteria from Chlorinated Waters. By M. Levine, P. Carpenter and J. M. Coblentz. Pp. 1511-1523.
124. *t.* Electro-Chemical Properties of Chlorinated Water. By F. C. Schmelkes, E. S. Horning, and G. A. Campbell. Pp. 1524-1538.
125. Super-Chlorination Practice in North America. By H. A. Faber. Pp. 1539-1560.
126. Typhoid in Large Cities of the United States in 1938. Pp. 1561-1574.
127. Tacoma's Water Works Construction Program. By W. Kunigk. Pp. 1575-1585.
128. Tacoma's New Store and Shop Building. By J. P. Pence. Pp. 1586-1596.

B *Journal, New England Water Works Ass'n.*
September

24. Manufacture of Alum, Ferric Sulphate and Sodium Aluminate. By F. A. Abbiati. Pp. 247-254.
25. Lime for Water Works Use. By J. G. Thompson. Pp. 255-260.
26. Copper Sulphate for Water Works Use. By E. Fitzpatrick. Pp. 261-264.
27. Activated Carbon - Manufacture and Specifications. By E. A. Sigworth. Pp. 265-270.
28. Laying Lined and Wrapped Steel Pipe at Needham, Mass. By R. G. Oakman. Pp. 271-273.
29. The Use of Lined and Wrapped Steel Pipe in the Augusta Water District. By S. S. Anthony. Pp. 274-277.
30. Factors Affecting the Cost of Distributing Systems. By W. W. Bush. Pp. 278-283.
31. Cleaning and Lining Existing Pipe Lines in Buenos Aires. By B. Harkness. Pp. 284-292.
32. Reconditioning Large Water Mains. By H. S. Jones. Pp. 293-298.
33. Safeguards for Ground-Water Supplies. By L. K. Sherman. Pp. 299-306.
34. Possible Pollution of Private Water Supplies. By E. J. Sullivan. Pp. 307-315.
35. Pollution of an Industrial Ground Water Supply by Organic Waste Products. By G. M. Fair. Pp. 316-317.
36. Non-Organic Pollution of Well Supplies. By E. S. Chase. Pp. 318-327.
37. Rapid Sand Filtration Plant for Willimantic, Conn. By R. F. Kittredge. Pp. 328-336.
38. Contacts with Town Water and Fire Departments. By P. C. Charnock. Pp. 337-344.
39. Maintenance of Water Works Equipment. By S. L. Rogers. Pp. 345-351.
40. Improvements in Power and Pumping Facilities of the Manchester Water Works. By P. A. Shaw. Pp. 352-357.
41. Comparison Between the 1916 and the 1938 Specifications for Gate Valves. By S. E. Killam. Pp. 358-361.
42. Some Popular Misconceptions Concerning the Function, Value and Significance of Water Analyses. By C. D. Howard. Pp. 362-371.
43. Ground Water in the Pre-Glacial Buried Valleys of Massachusetts. By I. B. Crosby. Pp. 372-383.

E *Engineering News-Record*
September 28

38. Inventory of Water Supply Facilities (in the United States). Pp. 60 and insert.

October 12

39. Tuning Up Pressure Regulators. By D. D. Gross. Pp. 54-56.
40. Underground Water in Court. P. 64.

F *Water Works Engineering*
September 27

79. Water Treatment Methods (in W. Va.) By P. L. McLaughlin. Pp. 1238-1243.
80. Studies on the Storage of Ferrous Sulphate. By W. A. Kramer and A. V. Graf. Pp. 1275-1276.

October 11

81. Elevated Water Tanks for Indianapolis. By W. C. Mabel. Pp. 1302-1307.
82. Private Water Company Practices (in W. Va.) By N. N. Wolpert. Pp. 1308-1312.
83. Training Employees to Make Good Joints on Water Mains. By W. M. Rapp. P. 1312.
84. *p.* Water Supply Practices of England. By J. Bowman. Pp. 1313-1315.
85. *p.* Some Observations on Water Softening. By D. E. Davis. Pp. 1319-1320, 1323.

G *Water Works & Sewerage*
October

39. Recarbonation of Lime-Softened Water. By L. H. Scott and F. C. Abbott. Pp. 381-385.
40. Evaluation of Economic Limits of Meter Maintenance. By D. R. Taylor. Pp. 386-391.
41. *p.* Maintenance of Water Works Equipment. By S. L. Rogers. Pp. 400-402.
42. Determination of the pH of Water. By F. R. McCrumb. Pp. 403-406.

J *American City*
October

23. Filter Plant Operation Aided by Proper Lighting. By H. O. Heiman. Pp. 47-48.
24. Water Rates and Service Charges. Pp. 81, 83, 85, 87, 89.

K *Proceedings, Am. Soc. of Civil Engineers*
September

6. *t.* The Unit Hydrograph Principle Applied to Small Watersheds. By E. F. Brater. Pp. 1191-1215.

October

7. *t.* Relation of the Statistical Theory of Turbulence to Hydraulics. By A. A. Kalinske. Pp. 1387-1406.

L *Civil Engineering*
August

10. Notes on the Hydraulic Jump. By F. C. Scobey. Pp. 467-469.
11. Engineering Aspects of the Influence of Forests on Mountain Streams. By R. A. Hertzler. Pp. 487-489.
12. Discharge of V-Notch Weirs at Low Heads. By F. W. Blaisdell. Pp. 495-496.

September

13. Protecting Chicago's Water Supply. By S. N. Kanick. Pp. 547-550.

M *Canadian Engineer*
September 26

8. *p.* Winter Operating Problems. By A. K. Grimmer. Pp. 2-3, 8.

October 10

9. *p.* Overhead Water Main River Crossing at Ottawa, Ont. By C. T. Heeney. Pp. 4-7.

P *Public Works*
October

42. Iron Bacteria: Classification, Identification and Corrective Measures. Pp. 22-23, 38.
43. *n.* Meter Operating and Maintenance Expense. P. 24.
44. Water Conservation in Honolulu. Pp. 25-26.
45. *n.* Toledo Water Supply Status. P. 28.

W *Johnson National Drillers Journal*
September-October

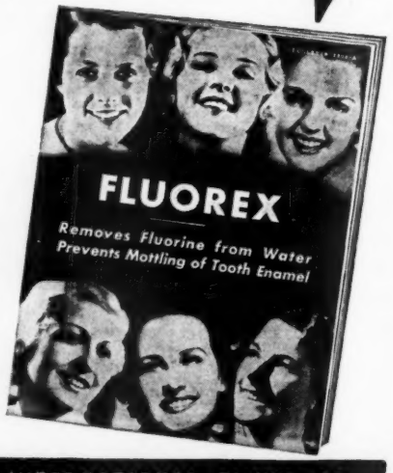
3. Testing for Ground Water. Pp. 1-3.
4. The Value of Geophysical Methods in Hydrologic Work. By O. E. Meinzer. Pp. 3-5.
5. Prospecting for Water in Palestine. By A. Lohnberg. Pp. 6. 7, 10-15.

HOW TO PREVENT MOTTLING OF TEETH

THE unsightly mottling of teeth caused by fluorine in the water supply severely handicaps thousands. It results in costly dentist bills too. And it is quite needless, for fluorine can be removed from water effectively and economically with Fluorex Purifiers, thus preventing this tooth destruction and the expense it causes.

Write for Bulletin

In what sections water supplies are likely to contain fluorine, how it attacks teeth, and how it can be removed with Fluorex Purifiers—all is discussed in Bulletin 2500-A. Write for your copy.



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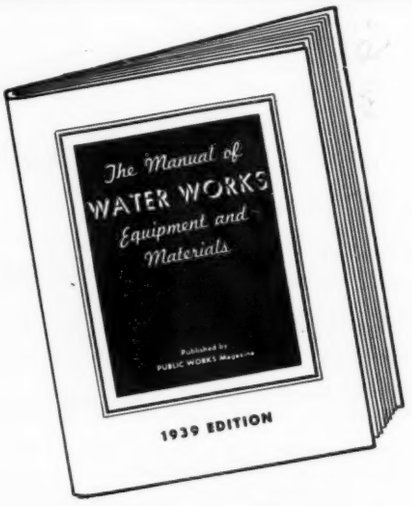

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Keeping Up With New Equipment

Saw-Tooth Ice, Snow and Maintenance Blade

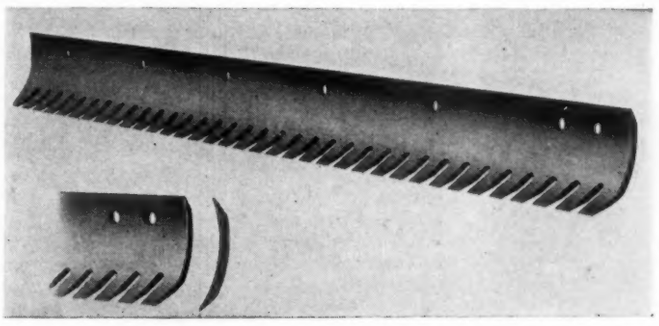
The Shunk Manufacturing Company of Bucyrus, Ohio, announce a new type blade, called the Shunk Saw-Tooth Ice, Snow, Sleet and Maintenance Blade. This is a special grader blade, with sharpened edges, and with a series of teeth cut angling in the lower edge.

The main features of the saw-tooth blade are the angle of the sharpened teeth which cut or score grooves parallel with the direction of travel, and the number of teeth in each blade. These blades are furnished to fit all types of graders, snow plows and maintainers, and merely replace the standard blade now on the equipment.

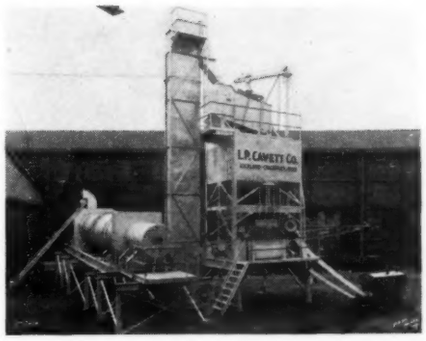
This blade will successfully remove most hazards caused by slippery and rutted streets and highways. Usually one trip over an icy or snow packed highway or street will roughen up the roadway sufficiently to reduce the skidding hazard to a minimum, and two or more trips will loosen up the packed snow and ice so a follow up of a regular grader or snow plow will remove the frozen material entirely.

This same Saw-Tooth type blade is used successfully in summer months to tear up black top, tar and macadam roads and for dirt and gravel road maintenance for eliminating washboard corrugation, ruts, ripples, chatter bumps, hollows and other irregularities.

In Colorado the Forest Bureau last season used regular blade graders equipped with the Saw-Tooth blade to roughen and cut the snow mat. In Michigan the Saw-Tooth blade was used quite extensively to score snow and ice so mixtures of calcium chloride and sand would remain in the scoring or grooves instead of being blown off the side of the road and this was very effective. Some of the larger cities used the Saw-Tooth blade to tear up the ruts and break up traffic-compacted snow and ice bound streets and by so doing enabled the snow and ice to be removed more quickly and effectively. Saw-Tooth blades were also used in Texas to tear up old stabilized mats and proved very satisfactory for breaking up the top crust. Further information on request.



Saw-Tooth Ice, Snow and Maintenance Blade.



H&B Portable Mixing Plant.

Portable Bituminous Mixing Plant

The outstanding feature of this plant is its extreme portability without sacrificing the substantial features of a stationary plant. The main units, that is, the mixer, screen, dial scales, etc., are identical with those used on a stationary plant.

This plant is built up in sectional units. A complete tower consists of mixer unit, weigh unit, bin unit, screen unit and elevator. All necessary transmission parts are permanently fixed to the individual units. The running parts of the tower, that is, the mixer, screen and hot material elevator, are all driven from one power unit.

The design of the weigh unit is probably the most outstanding feature of this plant. Heretofore, it has been necessary to completely dismantle the scales, weigh box, asphalt bucket and steam jacketed pipe in the mixing tower when moving. By making this unit self-contained, it is possible to leave all of these parts intact when the plant is dismantled.

Any of these units, with the exception of the elevator, may be hauled on a standard flat bed truck, as they are not over 8 ft. in width.

As shown on the folder, self-contained erection equipment may also be furnished with the plant. This eliminates the necessity of having a crane for erection of the plant. This tower may be put up easily in eight hours.

New Reflecting Material for Street Signs

A new reflecting street sign has just been introduced by A. D. Joslin Manufacturing Co. of Manistee, Michigan, which, while presenting an attractive day time appearance, can be seen clearly at night with very little light. This sign is fabricated from a new reflecting material produced by the Reflecting Metal Corporation, 343 South Dearborn St., Chicago, and sold as Arbuckle Reflecting Metal.

Arbuckle Reflecting Metal, it is claimed, will stand up indefinitely under ordinary outdoor weather conditions. It is processed from Alcoa Lighting Sheet a comparatively new product of the Aluminum Company of America, tests of which show that a loss of only 3% of reflectivity was sustained by the metal when exposed for three years to the sea-salt spray and other weather conditions at a spot only sixty feet from the Atlantic ocean.

The street sign illustrated is produced by embossing the street name on a sheet of Arbuckle Reflecting Metal, painting the background black and leaving the letters in the natural metal.

Reflecting Sign—night and day views.

To Slope High Banks Economically and Quickly

Something new in a sloping machine is the Cornett sloper, which can slope any high bank from nearly vertical to approximately horizontal. It can be attached to any power shovel in an hour's time. It is not necessary to remove the bucket, as the device can be attached to the ends of the shovel teeth. With the shovel boom elevated to approximately vertical, and a 20-ft. sloper boom, it is possible to reach about 38 feet, and the sloper boom can be made longer, if necessary.

This sloper was used on a bank 350 feet long and 35 feet high, the bank consisting of a layer of sand, a layer of hard clay and a layer of loam, each approximately 11 feet thick. The material to be sloped from the bank ranged from 4 inches to 2 feet thick. It required 8 hours to slope 12,250 square feet.

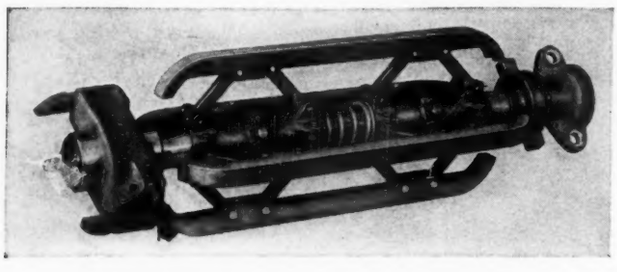
The Cornett bank sloper.

Full information will be sent on request to Cornett Sloper, 607 Degraw St., Brooklyn, N. Y.

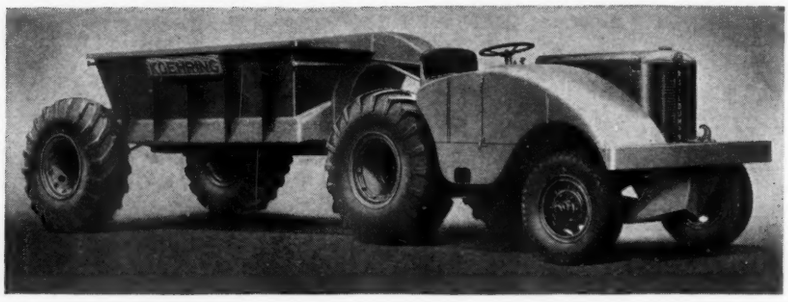
Hydraulic Sewer Cleaning Machine

The Joseph G. Pollard Co., Inc., 152 Ashland Place, Brooklyn, N. Y., is now producing a sewer cleaning machine which utilizes a hydraulic cleaning and scouring effect combined with the action of rotary knives and brushes to remove sand and gravel, roots, layers of incrustation, and similar obstructions from sewers and water mains. The cutting head of the machine is mounted on a hydraulically balanced simple bearing, and carries rugged knives and pivoted rotating brushes, the latter being forced against the pipe wall by centrifugal force. The arrangement of knives and brushes assures that all material will be removed from the line, since any objects lying too close to the sewer wall to be removed by the knives are scoured off by the brushes. Water passing through the cutting head performs the dual function of rotating the head and flushing the loosened material before the machine.

To operate with maximum efficiency, the cutting head must be maintained in the center of the sewer bore. This is provided by a carriage which adjusts automatically to correct for variations in structure, immovable obstructions, etc. A line of accessories for drawing the machine through sewers is also available.



The Pollard hydraulic sewer cleaner scrubs and cuts.



The Koehring dirt-moving unit—the Trail-Dump.

Lining Small-Diameter Tunnels

A folder issued by American Rolling Mill Co., Middletown, O., contains data on light-duty liner plates for small-diameter tunnels, with photographs and drawings. Tables give approximate weights of the plates used; information on structural strength.

Reflecting Metal

A 4-page folder tells about this new product which is especially adapted to use for signs and traffic directional and control installations. Reflecting Metal Corp., 343 South Dearborn St., Chicago, Ill.

Spreaders for Road Building and Maintenance

An atractive and instructive 8-page booklet listing stone, asphalt, chip, sand and road-widening spreaders. It gives essential facts regarding each unit and shows each in action by excellent photographs. Ask for Bulletin 232. Galion Iron Works & Mfg. Co., Galion, Ohio.

Dirt-Moving With the Koehring Trail-Dump

With speeds up to 20 miles an hour, the new Koehring Trail-Dump is a high-speed unit from the loading point to the dump and return. Both tractor and semi-trailer are pneumatic tired; turning radius is 10 feet. There are three sizes of tractor units—standard gasoline, diesel and super power gasoline, giving speeds of 16.5, 18 and 20 mph, respectively. Heaped load capacity is 8 cubic yards; struck capacity, 6½ cu. yds. Excellent booklet for those interested in dirt-moving. Koehring Co., Milwaukee, Wisc.

Sight Glasses for Pipe Lines to Indicate Duration of Flow

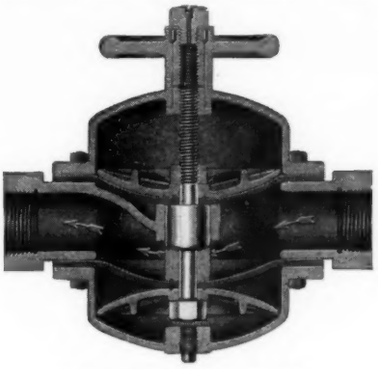
Many applications for a visible-flow fitting are found in plants and process industries to provide continuous checks on operation of equipment and observe the fluid in flow under pressure up to 125 lb. per square inch.

The Cochrane Sight Glass has been designed in six sizes for 2½, 3, 4, 5, 6, and 8 in. lines for any purpose where visual inspection of fluid flow is desired. Body is of cast iron and the window frame is of steel. Windows are made of Pyrex glass. The Sight Glass fitting is flanged for installation in the line and all sizes measure 13¼ in. between finished surfaces. Windows are 4¼ in. in diameter for all sizes. Weights range from 45 to 215 lb. Write Cochrane Corporation, 17th St. & Allegheny Avenue, Philadelphia for Data Sheet 2945.

The Cochran Sight Glass shows flow conditions in pipe line.

Diaphragm Valves with Glass, Rubber or Lead Lining

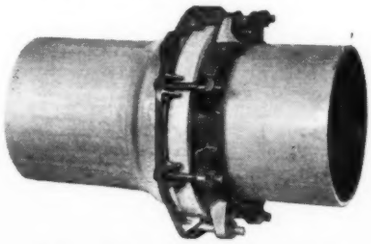
Diaphragm valves designed to control the flow of destructive or hard-to-handle liquids and gases has been announced by The McAlear Mfg. Co., 1901 S. Western Avenue, Chicago, Ill. These are of ferrous or non-ferrous construction and are glass-lined, rubber-



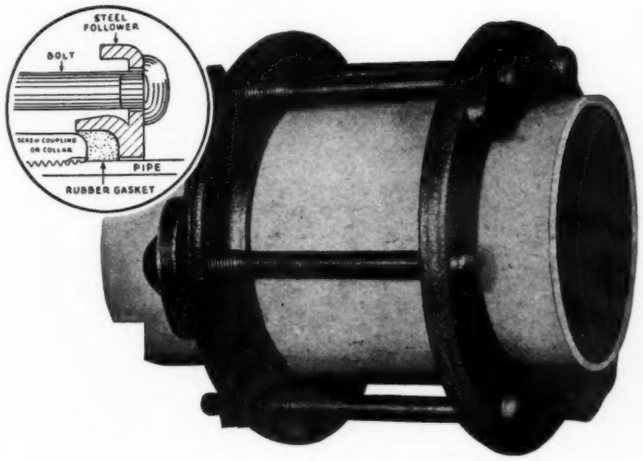
Valve for corrosive liquids.

lined or lead-lined, according to the service for which they are specified. They incorporate a diaphragm of pliable, synthetic composition compounded especially for specific applications. It has exceptional resistance to acids and alkalies, hot or cold, and medium pressures and temperatures do not affect it.

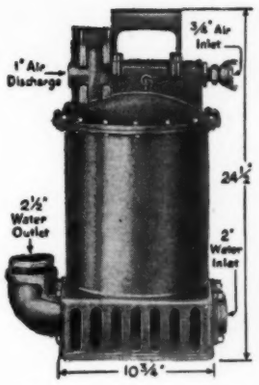
The ability to shut off tight, even with solid particles on the seat, also adapts these valves to vacuum service, and the absence of metal-to-metal contact when the valves close makes them well suited to service as non-pounding check valves. They operate in any position in the pipe line and freezing temperatures cannot damage them.



Dresser bell joint repair clamp.



Dresser Style 41 repair clamp.



Pneumatic Mud Pump.

Portable Air-Operated Mud Pump

This air-operated pump works on the ejector principle. It will handle water that contains up to 15% solids; water containing sand or drill cuttings will not cause rapid wear on expensive parts. It weighs 95 pounds, and will handle 65 gpm. at 50 ft. head; 20 gpm. at 200 ft. head. Fuller information from H. H. Sherman, Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.

Three Dresser Products

For quickly stopping leaks through the threads of screw collars, the style 41 repair clamp is used for pipe sizes 4½ to 12 inches, inclusive (inside diameter). For pipe ¾ to 4-inch, the clamp style 4 is used. For stopping leaks through the jointing material of bell and spigot joints, the style 60 clamp is used. These are available in sizes from 3 to 48 inches. They provide a permanent repair, without the necessity of cutting out and re-pouring the joint. The style 55 clamp is designed for the repair of leaky circumferential pipe welds and for small leaks and pinholes in pipes.

All of these repair units are simple and easy to install. Full descriptions are given in folders available from Dresser Mfg. Co., Bradford, Pa.

Bailey Meters Restyled

Bailey Meter Company, Cleveland, Ohio, has restyled its complete line of meters for power plants and industrial processes. Color and modernism as expected of industrial products today are expressed by a style plate which incorporates the Bailey trade-mark. This plate is embossed and colored so that the cir-

Restyled Bailey Meter.

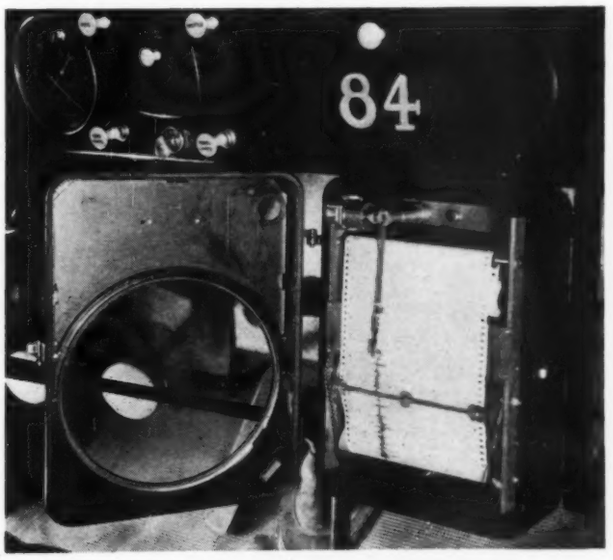
cular meter chart trade-mark stands out in silver on red from the black ribs of the vertical strip which forms its base.

Only the information necessary for reading of the chart record is now in sight. This is shown through the glass window of the meter.

Identification of the factor recorded by each pen is given on a small metal plate inside the glass window at the bottom of the chart. A distinctive color is used for each record.

Dow Recording Rufometer

The rufometer measures and records the relative roughness of roads. It is a product of the Dow Chemical Co. and is being used by the Dowflake Road Research Department in connection with road research and investigations. Road conditions are recorded on a strip chart as "bumps per mile." We do not know if this instrument is for sale, but interested readers may write Dow Chemical Co., Midland, Mich.



A "rufometer" installed in a car.

New Osgood Power Shovel Models

Osgood Co., Marion, O., has announced new models of their Type 60 power shovel, specifically the 605, which is a 1¼-yd. shovel, dragline, clamshell, crane and hoe, and the 600 a 1-yd. machine. Both are available in gasoline, diesel, oil and electric power. Excellent catalogs are available which give full information regarding details, including working ranges and lifting capacities. These will be sent on request to C. F. Ebert, Osgood Co., Marion, O.

Road Rollers

This is an unusually complete and excellent catalog and information book on road rollers. Each one of the Galion line is illustrated, and descriptions and specifications given. Included are the "Chief," with and without roll-a-plane attachment; the "Warrior," also with or without roll-a-plane; the "International" light weight roller; the Variable Weight tandem; the "Portable," a general service roller; the "trench roller"; and the "Sheepsfoot." Galion Iron Works and Mfg. Co., Galion, Ohio.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933.

OF PUBLIC WORKS, published monthly at New York, N. Y., for October 1, 1939.

State of New York } ss.
County of New York }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared J. T. Morris, who, having been duly sworn according to law, deposes and says that he is the Business Manager of the PUBLIC WORKS and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Public Works Journal Corp., 310 East 45th St., New York, N. Y.; editor, A. Prescott Folwell, 310 East 45th St., New York, N. Y.; managing editor, none; business manager, J. T. Morris, 310 East 45th St., New York, N. Y.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)

Public Works Journal Corp., J. T. Morris, W. A. Hardenbergh, Croxton Morris, A. Prescott Folwell and Anna Morris all of 310 East 45th St., New York, N. Y.; Wesley Hardenbergh, Golf, Ill. and Sumner N. Hume, address unknown.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) Bertha Morris, White Plains, N. Y.; Elizabeth Hardenbergh, White Sulphur Springs, N. Y.; Mary Sunderland, Liberty, N. Y.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the twelve months preceding the date shown above is ..... (This information is required from daily publications only.)

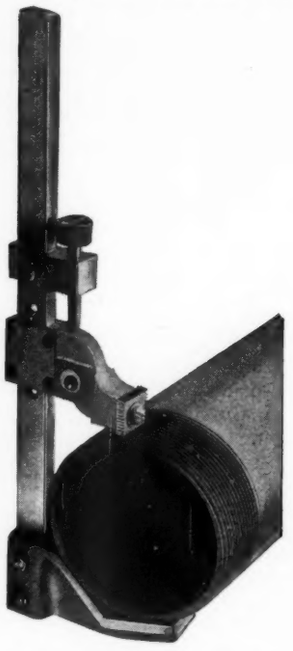
J. T. MORRIS, Business Manager.

Sworn to and subscribed before me this 30th day of September, 1939.

CROXTON MORRIS,
Notary Public, Westchester County, N. Y
Cert. filed in N. Y. Co. No. 847, Reg. No. I-M-512.
Commission expires March 30, 1941
(Seal)

New Outside Thread Chaser

A new, handy, quick, dependable and inexpensive method of restoring and cleaning damaged, crossed or battered threads on outside diameters from 1" to 5"—with either right or left-hand thread—is provided by the new OTC Outside Thread Chaser. This practical little tool with its 15 different thread pitches (threads per inch) has a wide range of application, including fire hose connections, couplings and fire hydrants. When the damaged part cannot be chucked in a lathe, or when new parts are not quickly available — as in fire-fighting service, water works, power plants, etc.—the OTC Thread Chaser is often a "life saver."



For restoring damaged pipe threads.

Six chaser dies are furnished; two dies having four pitches, 8, 10, 12, 14 and 16, 18, 20, 24, while four additional chaser dies have two pitches each, 4 and 5; 6 and 7, 7½ and 9 and 8 and 11½ threads per inch. This range covers practically all threads, including pipe, found on outside diameters from 1" to 5". For additional information on this and other special tools write to Owatonna Tool Company, 374 Cedar St., Owatonna, Minnesota.

Universal Announces New ¾ Yard Excavator

Universal Power Shovel Corporation, Milwaukee, Wisconsin, announces a new ¾-yard shovel, the "1020" model. Unusually lightweight construction; equipped with 19' boom and 14' stick to provide ample reach and dip for practically any type of job; crawlers are 11' 5" x 20". All gears and bearings are fully enclosed in a dust-proof, oil-tight one-piece cast case. The Unit 1020 is convertible to all attachments. New literature, describing this machine in detail, is available.

Allis-Chalmers Model S Tractor

This is a new tractor designed to take advantage of the extra power in high octane (64-72) gasolines now available. The tractor has a drawbar horsepower of 64.5, which is attained with low fuel consumption by means of high compression. It is equipped with roller tracks which need lubrication only once in 200 hours. A full description is given in a 24-page booklet. Allis-Chalmers Mfg. Co., Tractor Division, Milwaukee, Wis.

Plunger-Diaphragm Solution Feeder:

A new plunger-diaphragm type solution chemical feeder for volumetrically measuring and pumping clear, corrosive liquids, made by International Filter Co., 325 W. 25th Place, Chicago, Ill., is described in Bulletin No. 360. Copies on request.

Rock Drills:

Ingersoll-Rand Co., New York, N. Y., has issued a catalog, 88 pages, well illustrated, which includes a brief history of rock drill development, with interesting pictures of the days when the well-dressed hard rock man wore a derby. Catalog 4301.

Blower and Exhausters

This 20-page bulletin gives a lot of information on the use of single and multi-stage blowers and exhausters, with charts, diagrams, and data. Roots-Connersville Blower Corp., Connersville, Ind.

Road Maintainers:

Bulletin 40 describes the new line of road maintainers for under-truck mounting. Blades from 8 to 14 feet in length are availbale, with hydraulic controls. Monarch Road Machinery Co., Grand Rapids, Mich.

Unit ¾-yard excavator.

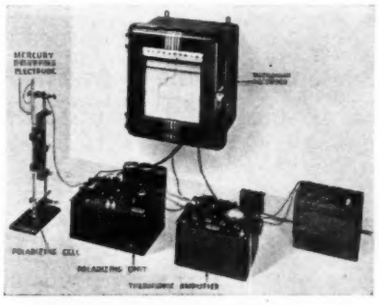
Richard W. Yerkes

Harry E. Kellogg

Mr. Yerkes after 50 years has resigned as treasurer of Link-Belt Co. and Mr. Kellogg has been made treasurer.

The Electro-Chemograph

Applying the dropping mercury electrode principle of analysis, Leeds & Northrup's new Electro-Chemograph automatically inks curves from which quantitative and qualitative analyses can be determined. Making possible quick and convenient analyses in those processes where its possibilities have been determined, the method eliminates dark rooms, developing processes and delicate galvanometer systems. Drawn in sight of the operator, the curve is inked on a wide, easily-read, permanent chart.



Publication E-94 (1) tells about it.

This equipment is described in L&N's Technical Publication E-94(1). A copy will be sent upon request to Leeds and Northrup Company, 4934 Stenton Avenue, Philadelphia, Pennsylvania.

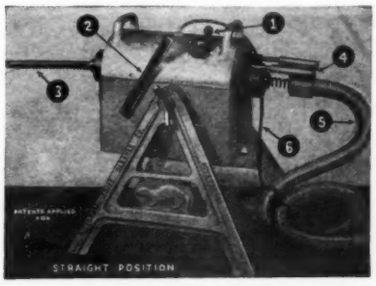
Paint and the Maintenance Man

One of the problems of State, County and Municipal maintenance departments is that of adequate protection against corrosion of all metal structures such as bridges, roofings, steel frameworks, road signs, etc., plus the economical exterior and interior painting of all public buildings.

On metal structures, red lead has long been widely used as a priming coat—it is usually applied to all metal structural parts before delivery—for it will inhibit rust. A small break or crack in the paint film will not result in the gradual destruction of the entire surface as red lead forms an even wearing, firm, but elastic, film which has a great affinity for metal.

For dark colored finishes on metal, colors-in-oil should be added to the body and finish coats of red lead, but for light colored finishes, white lead should be used. There has been a considerable development in the manufacturing technique in this latter product. Greater coverage, higher light reflective powers (an important factor in the painting of highway structures) and in brushability and durability.

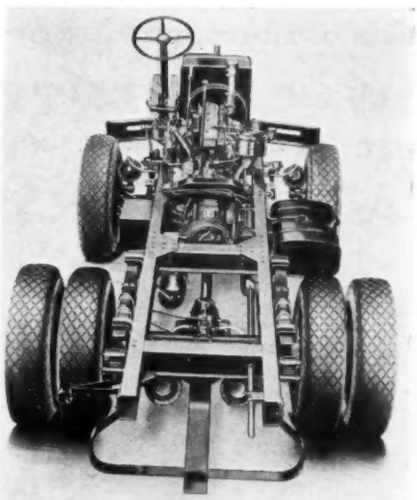
In the preservation of wood and other surfaces, white lead is important. It reacts actively with linseed oil to form a firm and elastic film which permeates the wood cells or minute open spaces of other building materials so that a highly durable, deeply penetrative coating results. Used on metal structures primed with red lead it gives double protection to the metal and when it becomes necessary to repaint, the old surface will not have to be removed, obviating the need for a new priming coat.



This is a new power pipe cleaner for drains, sewers, coils, etc., up to 6" or 8". Pittsburgh Pipe Cleaner Co., Pittsburgh.

Architectural Concrete Slabs

Among the most interesting recent developments in concrete construction are the architectural concrete slabs developed by John J. Earley of Washington, D. C. These are reinforced precast slabs made in various shapes and sizes with a white cement matrix to set off exposed aggregates in their true colors and textures. Sizes are up to 100 sq. ft. or more, in all shapes; the material is scientifically proportioned; reinforcement consists of welded mats; colors and designs are available. Mr. Earley described the processes and the developments in a recent most interesting and instructive talk to a group of guests of the Universal Atlas Cement Co. The new office of this company has been treated with these precast slabs. A booklet available from Universal Atlas Cement Co., Chrysler Bldg., New York City, N. Y., illustrates many of the designs. Further information is also available on request.



International Heavy-Duty Cab-Over-Engine truck chassis. Made in four sizes, with ratings of 6 to 9 tons, including cab, body equipment and pay load.

New Appointments and Personal News

The following appointments have been reported:

Edwin A. Ingham, City Manager, Glendale, Calif.

E. M. McHugh, Supt., Ironwood Water & Gas Dept., Ironwood, Mich.

Conrad Schafer, Supt. Water Dept., Hastings, Nebr.

Lloyd K. Clark, Dir., Division of Sanitary Engrg., State Dept. of Health, Bismarck, N. D.

W. J. Moore, Supt. Water Works, Eugene, Ore.

C. W. Barwis, Warren County Engr., Warren, Pa.

Thomas C. Green, Supt., Water & Sewage Treatment, Austin, Tex.

W. J. Gallagher, City Engr., Rock Island, Ill.

L. C. Whitsit, City Engr., Highland Park, Mich.

C. A. Franzen, Supt. Public Works, Salamanca, N. Y.

C. H. Weatherell, Jr., City Engr., Olean, N. Y.

David W. Carmichael, Boro Engr. and Water Works Superintendent, Hawthorne, N. J.

Mr. Taylor, City Engr., Greenville, Ala.

B. H. Freeland, City Engr., Bluffton, Ind.

C. A. Aldrich, Nance County Surveyor, Fullerton, Nebr.

Harry C. Louden, Water Works Director, Fairmont, W. Va.

Orrin Wells, Kalkaska County Rd. Supt., Kalkaska, Mich.

A. Peterson, Mgr., Chillicothe Municipal Utilities, Chillicothe, Mo.

E. T. Brown, City Engr., Fayetteville, Ark.

W. R. Deal, Chrmn., County Comrs. for Bryan Co., Pembroke, Ga.

Ray McGrath, Prowers County Comnr., Lamar, Colo.

I. H. Reed, Mgr., Sedalia Water Co., 111 W. 4th St., Sedalia, Mo.

Clair A. Inskeep, Logan Co. Engr., Bellefontaine, Ohio.

Joseph Burhans, Supt. Water Dept., Ellenville, N. Y.

J. A. Angelotti, City Engr., Rankin, Pa.

Fred S. Cresswell, formerly engineer for the Public Works Administration at Washington, D. C., has been appointed promotion engineer for the Clay Sewer Pipe Association.

John C. Michie, for 38 years superintendent of the Durham, N. C., Water Department, died October 12. Col. Michie was a life member of the AWWA and long a leader in sanitary engineering affairs in North Carolina.

OVER THERE—War lords parley, swap strategy, draft battlefield blueprints, engineer devices to destroy humanity! **OVER HERE—American Road Builders prepare to meet at the Road Show-Convention to seek new ideas, to share methods, to solve problems, to plan better and safer roads for the enjoyment and advancement of mankind.**

OVER THERE—Factory wheels turn faster, workers produce instruments of death and disability, engines of destruction make their debut behind the trenches! **OVER HERE—Manufacturers of road-building materials and machinery also operate at top speed, make ready new products for preview in Chicago—equipment to build tomorrow's roads.**

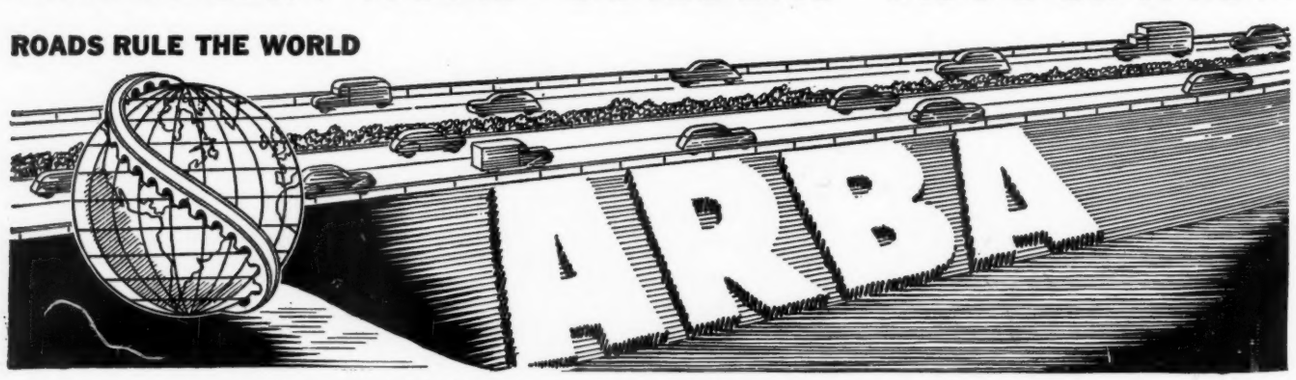
OVER THERE—Selfish leaders dictate action to bring about wholesale slaughter and the doom of progress! **OVER HERE—Highway planners, designers, administrators and builders will hear Federal Works Administrator John M. Carmody, Senator Carl Hayden of Arizona, Congressman Wilburn Cartwright of Oklahoma and Public Roads Commissioner Thomas H. MacDonald in up-to-the-minute talks about construction for peace, prosperity and progress.**

1940 ROAD SHOW - CONVENTION • CHICAGO

INTERNATIONAL AMPHITHEATER JANUARY 29—FEBRUARY 2

AMERICAN ROAD BUILDERS' ASSOCIATION

ROADS RULE THE WORLD



Readers' Service Department

These helpful booklets are FREE. Write to the firm whose name is given, mentioning PUBLIC WORKS, or to this magazine.

(Continued from page 56)

are described and illustrated in data sheets issued by San-Equip Inc., 700 Brighton Ave., Syracuse, N. Y.

Sludge Drying and Incineration

439. The five basic steps of: sludge preparation; flash drying; incineration; deodorization; and dust collection are explained in a new 24 page booklet, No. 6781 issued by The Dorr Company, 570 Lexington Ave., New York, N. Y., sales representatives for the C-E Raymond system of sludge drying and incineration.

440. Disposal of Municipal Refuse: Planning a disposal system; specifications. The production of refuse, weights, volume, characteristics. Fuel requirements for incineration. Also detailed outline of factors involved in preparation of plans and specifications. Morse-Boulger Destructor Co., 216P East 45th St., N. Y.

444. A new booklet "Essential Factors in the Design and Layout of Swimming Pool Systems," with data on filtration equipment, fittings, solution feeders, accessories, etc., is available from Everson Manufacturing Co., 213 West Huron St., Chicago, Ill.

445. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data, prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

447. "Painting Swimming Pools," an interesting booklet by Dr. A. F. Pistor, covers the subject thoroughly, discussing objectively the relative merits of the different types of coatings recommended for that purpose. Write Inertol Co., 401 Broadway, New York, N. Y.

Taste and Odor Control

448. How, when, and where activated carbon can and should be used to remove all kinds of tastes and odors from water supplies is told in a booklet issued by Industrial Chemical Sales Div., 230 Park Ave., New York, N. Y. 77 pages, tables, illustrations and usable data.

Treatment

450. "Safe Sanitation for a Nation," an interesting booklet containing thumbnail descriptions of the different pieces of P.F.T. equipment for sewage treatment. Includes photos of various installations and complete list of literature available from this company. Write Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago, Ill.

451. "Soft Water for Your Community," tells by means of many interesting pictures and text the advantages of soft water to any community. Ask for a copy from The Permutit Co., Dept. G4, 330 West 42nd St., New York, N. Y.

454. New 16-page illustrated catalog No. 1742 on Straightline Collectors for the efficient, continuous removal of sludge from rectangular tanks at sewage and water plants. Contains layout drawings, installation pictures, and capacity tables. Address Link-Belt Co., 2045 West Hunting Park Ave., Philadelphia, Pa.

460. This new 145 page illustrated chemical products book contains 55 pages of Tables, Factors and valuable Reference Data. Issued by General Chemical Co., 40 Rector St., New York, N. Y.

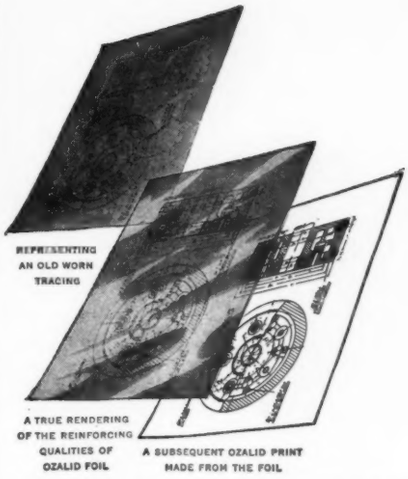
461. Ferrisul for Water and Sewage Treatment. Handy booklet describing Ferrisul and telling how it is used. Merrimac Chemical Div., Everett Station, Boston, Mass.

Valves and Hydrants

470. Complete booklet with much worthwhile water works data describes fully Ludlow hydrants and valves. Sent on request. Ludlow Valve Mfg. Co., Troy, N. Y.

Water Works Operating Practices

490. "Important Factors in Coagulation" is an excellent review with bibliography and outlines of latest work done in the field. Written by Burton W. Graham and sent free on request to Activated Alum Corp., Curtis Bay, Baltimore, Md.


REPRESENTING AN OLD WORN TRACING
A TRUE RENDERING OF THE REINFORCING QUALITIES OF OZALID FOIL
A SUBSEQUENT OZALID PRINT MADE FROM THE FOIL

Ozalid—a better method for good prints from drawings.

Burners and Torches for Highway Work

Bulletin "A" is a 12-page publication which describes in detail the line of blowers and torches manufactured by the American Steel Works, Kansas City, Mo.

Power and Battery Operated Highway Signals

Catalog B, Welsbach Traffic Signal Co., 122 So. Michigan Ave., Chicago, Ill., illustrates and describes signals for traffic control manufactured by this company.

Rooters and Tractor Cranes

The Rooter Folder is based on actual job data. It shows how a rooter can be used to extend scraper savings over a 30% range and give more pay load profit in 40% faster loading time in hardpan, shale, gravel, limestone and frozen ground. The Crane Folder shows how this unit can profitably handle heavy and awkward loads. R. G. LeTourneau, Inc., Peoria, Ill.

New Goodyear YKL heavy duty truck tire.

American Public Works Association

The 45th annual convention of this association was held at Pittsburgh, Pa., Oct. 9 to 11. Excellent papers and interesting round-table luncheon meetings were features of the meeting. The newly elected officers of the association are: President, John S. Flockhart; Roy L. Phillips and F. T. Paul, 1st and 2nd vice presidents; and H. L. Howe, treasurer. Frank W. Herring, executive director, 1313 East 60th St., Chicago, Ill., did a fine job in arranging and directing the meetings.

Highway Research Board

The 19th annual meeting of the Highway Research Board will be held at the National Academy of Science, Washington, D. C., December 5 to December 8. On the 5th, soils, material and construction, roadside development and design will be considered; on the 6th, economics, maintenance, design and traffic and finance; on the 7th, finance, materials, construction and soils; on the 8th, traffic and maintenance, design and roadside development. R. W. Crum, National Research Council, Washington, D. C., will furnish fuller details.

American Road Builders' Association

The nomination committee of the ARBA has submitted the following official nominees for officers and directors of the Association for 1940-1941:

President: H. G. Sours, Assistant Director and Chief Engineer, State Highway Department, Columbus, Ohio; Vice Presidents: Paul B. Reinhold, Secretary-Treasurer, Reinhold & Co., Inc., Pittsburgh, Pa.; John E. Ballenger, President, Ballenger Construction Co., Lakeland, Fla.; Lion Gardiner, Vice President, Jaeger Machine Co., Columbus, Ohio; Stanley Abel, Supervisor, Fourth District, Kern County, Taft, Calif.

For Treasurer: George F. Schlesinger, Engineer-Director, National Paving Brick Association, Washington, D. C. For Directors, term ending 1943: R. L. Baldock, State Highway Engineer, Salem, Ore.; Robert B. Brooks, Consulting Engineer, St. Louis, Mo.; J. F. Cast, Manufacturers' Sales Manager, Firestone Tire and Rubber Co., Akron, Ohio; Paul L. Griffiths, Vice President, Koppers Company, Pittsburgh, Pa.; A. E. O'Brien, Secretary, Associated Pennsylvania Constructors, Harrisburg, Pa.; M. P. O'Connor, J. C. O'Connor & Sons, Fort Wayne, Indiana; J. E. Pennybacker, Managing Director, The Asphalt Institute, New York, N. Y.

SEWAGE PLANT OPERATOR WANTED

New sewage treatment plant in New York metropolitan area wants applications from men qualified to operate activated sludge plant. Starting salary $3000 per year. No residence requirements. Applications must reach this office by November 17. Address Public Works Magazine, 310 East 45th Street, New York, N. Y., and send full details of experience with your first letter.

Why you need a SMITH AIR COMPRESSOR

PORTABILITY
Think of the many advantages of such a light weight, portable compressor! Move it easily from one job to another. Tow it at permissible truck speeds.
DEPENDABILITY
A stand-out in performance! It's ruggedness and efficiency are sources of constant satisfaction to owners everywhere.
ECONOMY
Uses only one gallon of gasoline an hour! Repair parts are available at Ford dealers everywhere.

And, best of all, a Smith Compressor is priced at LESS THAN HALF THE COST of a standard compressor of equal capacity! 60 cu. ft. a minute capacity—all the power you'll need to operate rock drills and paving breakers. Pressure up to 175 lbs. a square inch. Head equipped with high speed compressor valves; automatic unloading and idling.

With a Ford Motor and shop facilities you can assemble your own compressor. We will furnish a Smith Compressor Head and Accessories with instructions for mounting.

Write Today!

GORDON SMITH & CO.

420 College St., Bowling Green, Ky.

For the Engineer's Library

Brief reviews of the latest books, booklets and catalogs for the public works engineer.

Soil-Cement Roads:

How to build low-cost roads for light traffic by mixing roadway soil with portland cement and water is told in detail in a 90-page manual just issued by the Portland Cement Association, 33 West Grand Avenue, Chicago. We believe the manual will be sent on request, without charge.

Soil-cement roads—which the Association characterizes as "The new answer to the light traffic road problem"—require careful laboratory analyses and tests of soils coupled with studied construction procedure to assure their success. What these tests and procedures consist in form the body of the manual. Although scientific, the manual points out that both laboratory and construction procedures are simple.

In the Association's Development Department, laboratory and testing procedures have been in progress for almost five years. Approximately 1,000 soil samples ranging from a coarse sand to a very heavy clay have been examined and their durability as road material when mixed with portland cement determined. Field construction procedure and equipment requirements have been evolved from experience gained on over 111 projects scattered through 28 states.

In "Soil-Cement Roads," the plans engineer will find details for laying out the project; the laboratory soils engineer will find an outline of tests required to insure success; the resident engineer and contractor will find answers to questions regarding desirable equipment and procedures; the specification engineer will find a model specification; the estimating engineer will find cost data listed; and the field soils engineer will find the detail information required for calculating control factors during construction.

The handbook also indicates uses for soil-cement mixtures other than for road construction.

Highway Ice Control:

A' new booklet, "Highway Ice Control—Methods, Materials and Equipment" gives a resume of present ice control practices in use in various sections of the country, and, in addition, contains new facts recently developed by well-known authorities. Among other things, it contains abstracts of reports on tests showing the differences in frictional value of cinders, sand and other abrasives, together with reports showing exactly how much the calcium chloride treatment adds to the skidproofing effectiveness of abrasives. It also includes sections on covered vs. uncovered stock piles—permanent vs. temporary covers—skidproofing vs. removal of ice. Copies of this valuable book may be secured without charge or obligation by writing to Solvay Sales Corporation, 40 Rector Street, New York, N. Y.

Index to ADVERTISEMENTS

Aeroil Burner Co., Inc. 41
Alvord, Burdick & Howson 47
American Road Builders Assn. 54
Armco Drainage Products Assn. 6
Ashdown, Williams & Co. 47

Black & Veatch 47
Browne, Floyd G. 47
Buck, Seifert & Jost 47
Buffalo-Springfield Roller Co. 37

Caird, James M. 47
Cast Iron Pipe Research Assn. 2
C. H. & E. Mfg. Co. 40

De Witt Hotels 36
Dow, A. W., Inc. 47

Everson Mfg. Co. ..... Front Cover

Fairbanks-Morse & Co. 4
Ford Meter Box Co. 45
Frink, Mfr., Carl H. 29

Globe Instrument Mfg. Co. 45
Goodyear Tire & Rubber Co. 3
Gohi Culvert Mfrs., Inc. 35
Gorman-Rupp Co. 37
Greeley & Hansen 47
Green Co., Howard R. 47

Harrub Engineering Co. 47
Highway & Street Manual 36
Huber Mfg. Co. 30

Industrial Chemical Sales Div. 5
International Filter Co. 46
International Salt Co. 59

Jaeger Machine Co. ..... 33 & 41

Layne & Bowler, Inc. 43
Lock Joint Pipe Co. 43

Manual of Sewage Disposal Equipment and Sewer Construction 48
Manual of Water Works Equipment and Materials 46
Metcalf & Eddy 47
Morse Boulger Destructor Co. 41

Pacific Flush Tank Co. 40
Pirnie, Malcolm 47
Potter, Alexander 47
Proportioneers, Inc. 40

Quinn Wire & Iron Works 30

Robert & Co. 48
Roberts Filter Mfg. Co. 8
Russell & Axon Cons. Engrs., Inc. 48

Simplex Valve & Meter Co. 45
Smith & Co., Gordon 58
Snell, Inc., Foster D. 48
South Bend Foundry Co. 41
Stewart, W. H. 40

U. S. Pipe & Foundry Co. 39

Wallace & Tiernan Co. ..... Back Cover
Wiedeman & Singleton 48
Wilson Engr. Co. 48